LABORATORY PRACTICE

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VOL. 9 No. 2 Published Monthly FEBRUARY 1960

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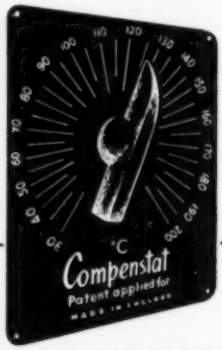

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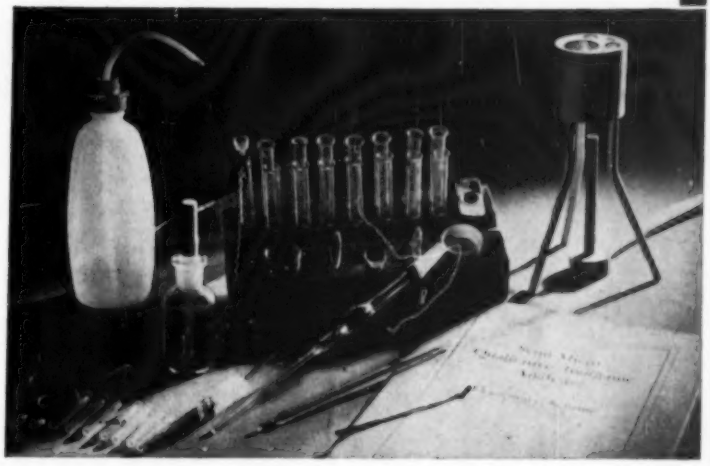

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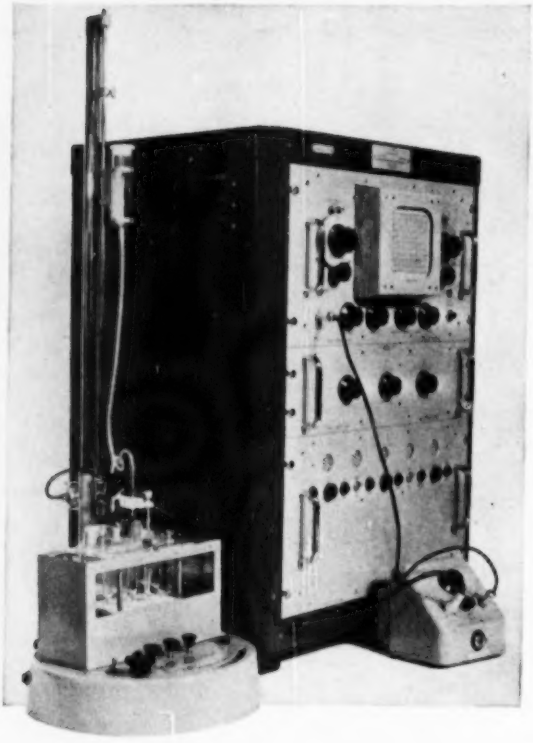

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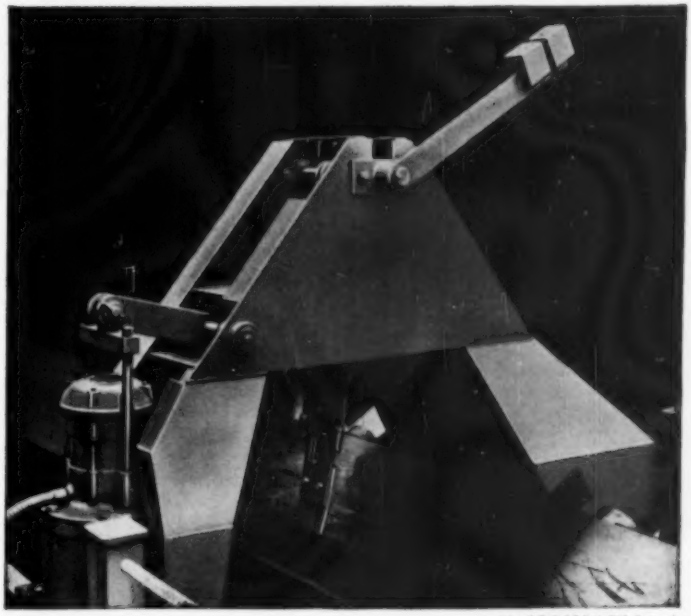

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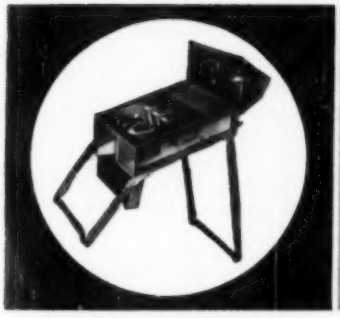

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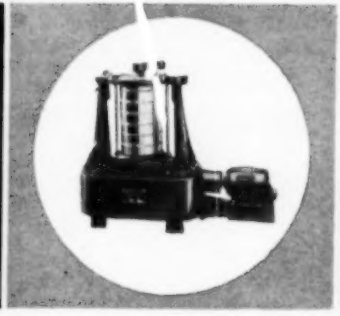

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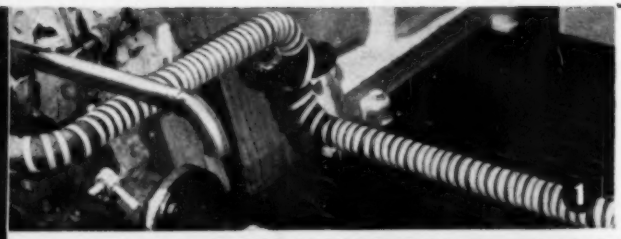

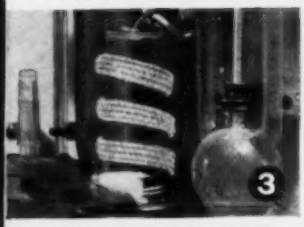

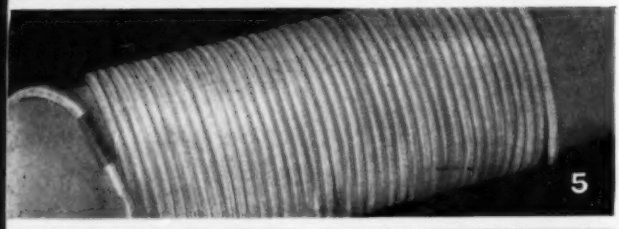

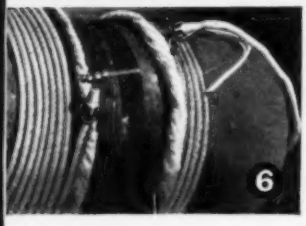

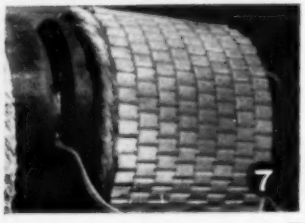

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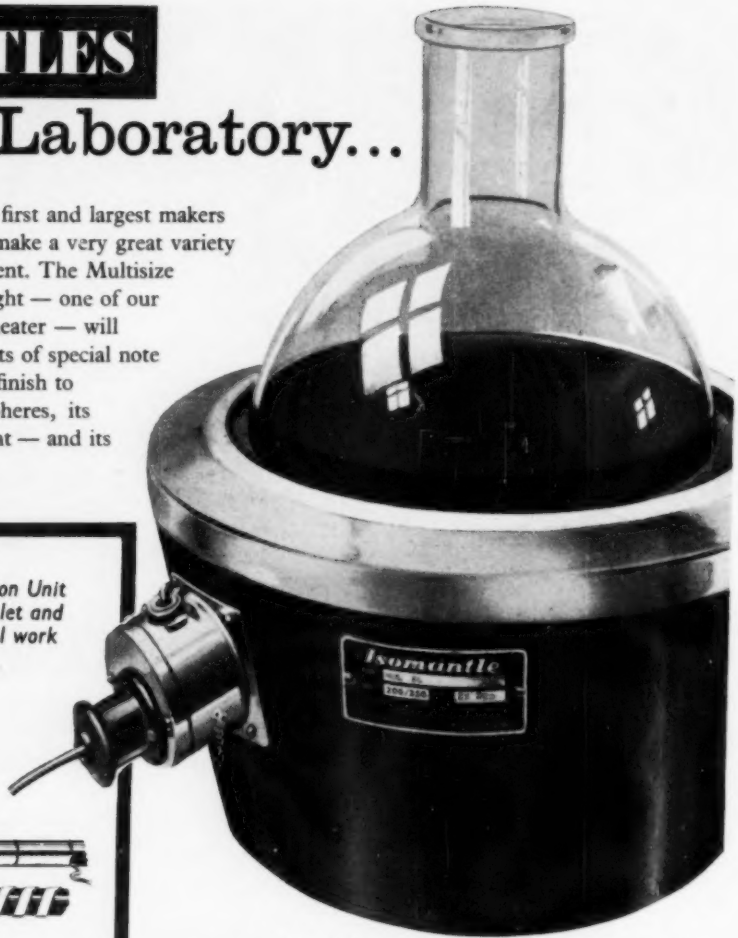

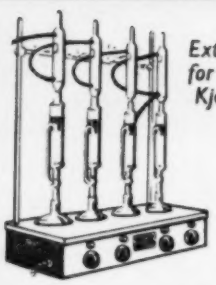

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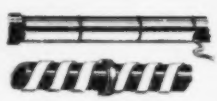

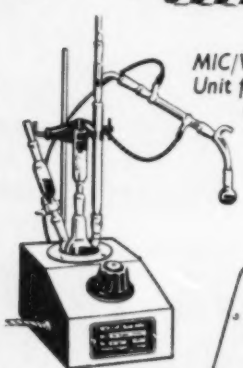

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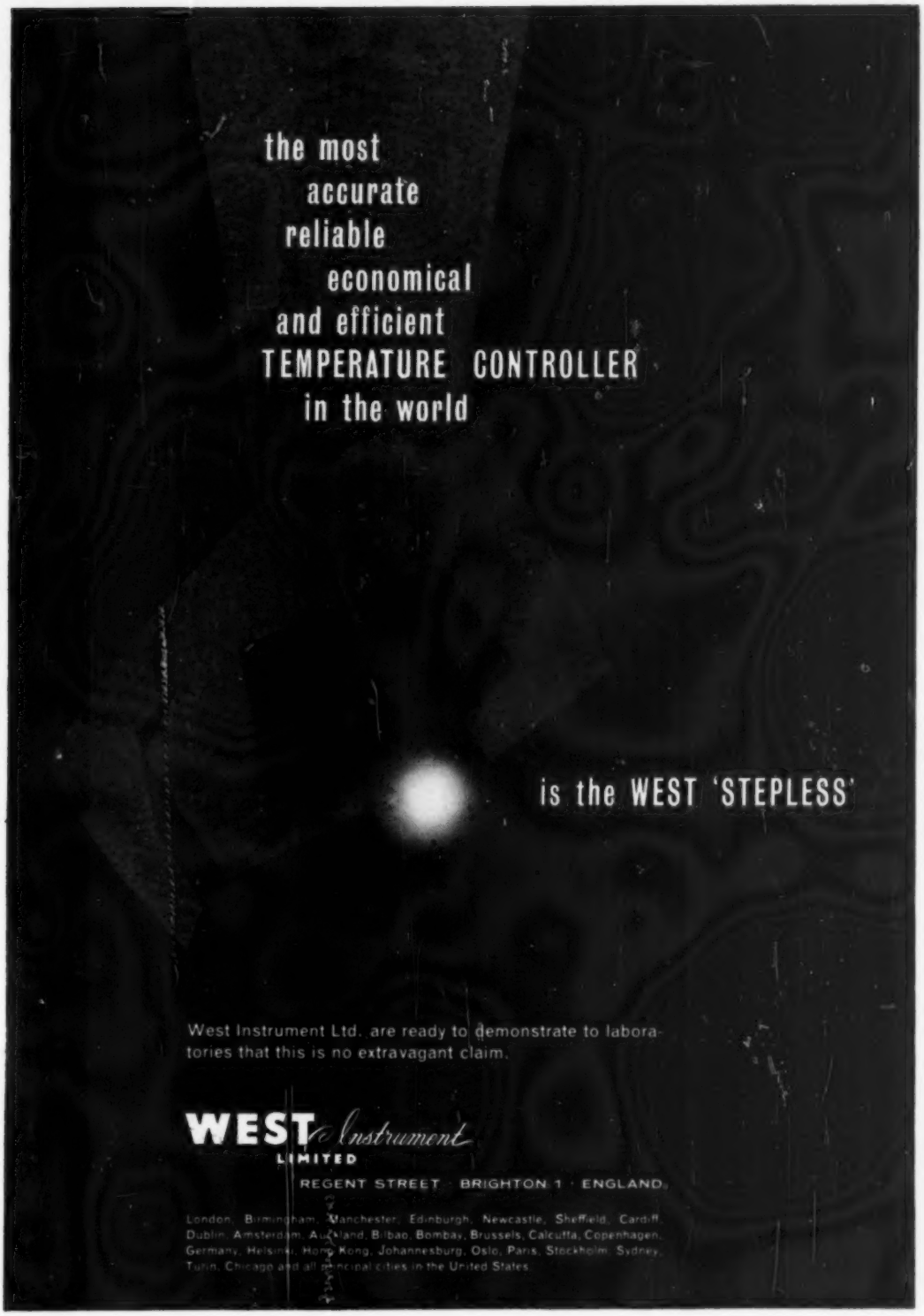
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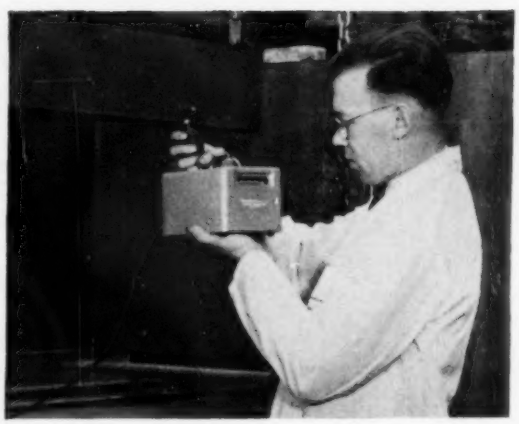

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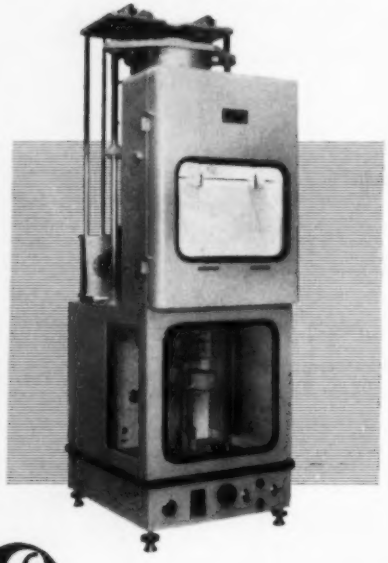

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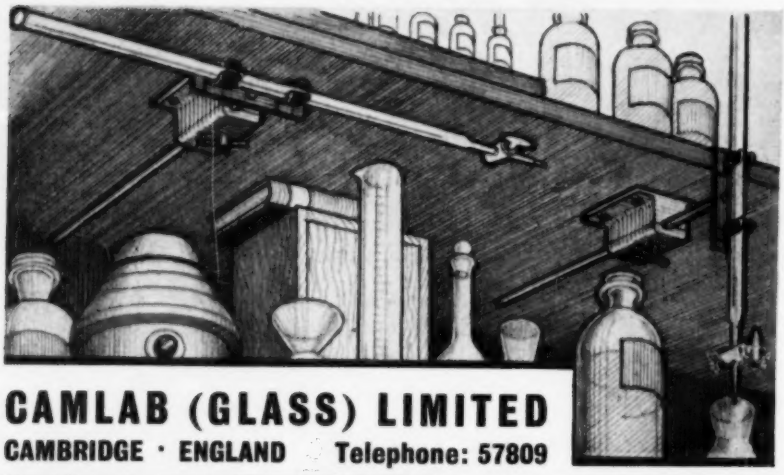

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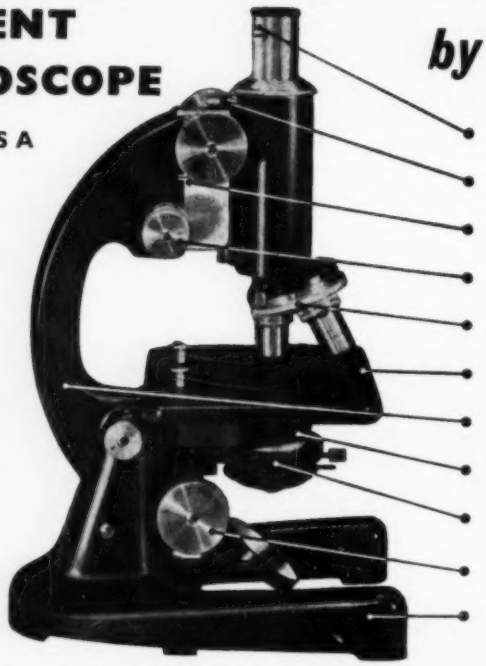

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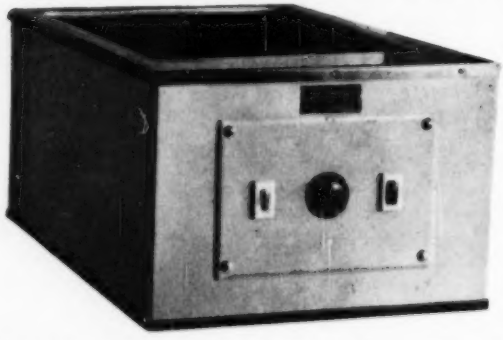

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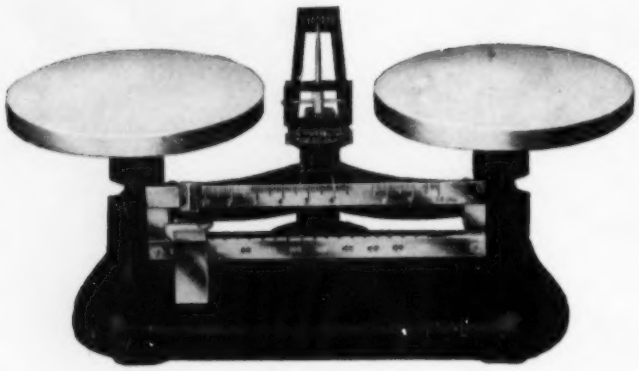

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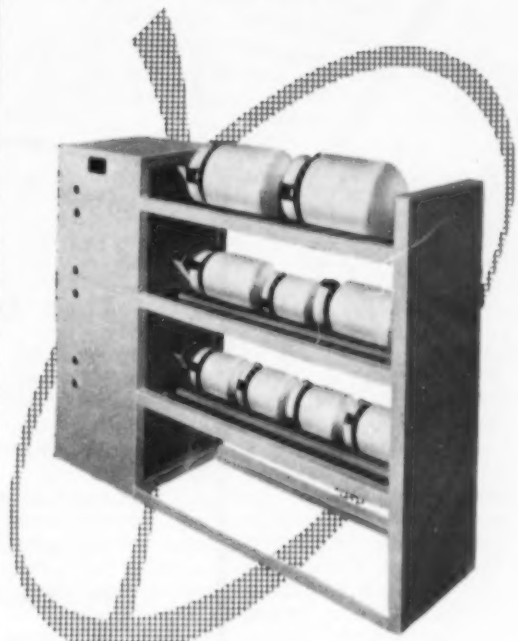

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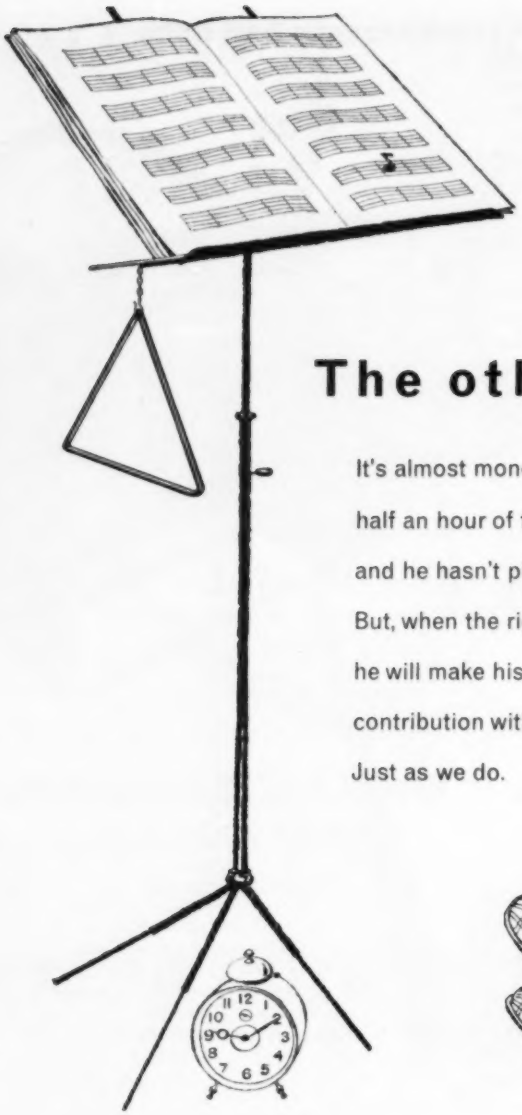
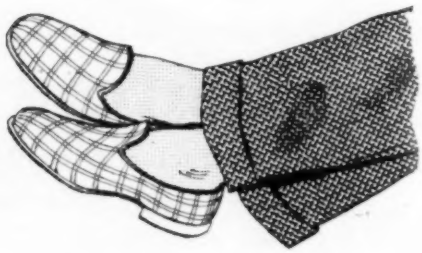


The other man's job—

It's almost money for jam—
half an hour of the symphony gone
and he hasn't played a note.
But, when the right moment comes
he will make his
contribution with precision.
Just as we do.



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Vol. 9 FEBRUARY 1960 No. 2

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EDITORIAL

Some Desirable Acts of Uniformity

THE trend to larger units of production, automation in industry and a scientific approach to costs of production are all leading steadily to a reduction in types of consumer goods. In the car industry mergers have been such that today there may be five cars, each bearing a long-established and honoured name, and yet all five being virtually the same, differing only in radiator appearance and a few other unimportant details. Where this system results in better value for the consumer there is much to be said for it. There is, however, inevitably a reaction on the part of those who like life to be interesting and varied, and resent the dull sameness which arises from mass production methods. In some aspects of scientific work standardization is highly desirable, for example in apparatus and analytical methods. In other aspects there is a complete absence of uniformity, for example the organization of scientific societies, laboratories, institutions, research organizations, journals, methods of writing papers, the listing of references, tables of contents and summaries, and especially the format of journals.

The literature of science is so vast today and is increasing so rapidly, doubling itself every seven or eight years at the present rate, that all bibliographical work should be simplified as much as possible. Nearly all scientific papers give references to other papers in their introductory section, and such references are often a very valuable feature of a paper. Indeed, some workers rely on references in recent papers rather than on abstracts and indexes to become acquainted with the literature of a given subject. In spite of the existence of a World List of abbreviations for journals, not all publishing houses rely on this and consequently there may be occasional misunderstandings. There is today not only an urgent need for a universal list of abbreviations but for a universally used list of really abbreviated abbreviations. Some are practically the full name of the journal and the place of origin. It is true that the number of scientific and technical journals now amounts to many thousands throughout the world, but in practice readers of scientific papers are familiar with journals, or at least the names of journals, in their own field.

References in chemical papers are almost entirely confined to chemical journals, in zoological papers to zoological journals, and so on. It is comparatively rare for a scientist to come across a scientific journal of importance in his own field of which he has never heard before. Librarians and others who work in many fields have their works of reference always available. Is it necessary, therefore, for authors and printers to have to put, for example, 'Ann. Inst. nat. Rech. agron. Paris, Sér. E. (Ann. Tech. Agron.)' in their references every time they refer to this journal? Admittedly this is an extreme case, but there are many long abbreviations. Why increase complexity by using capitals for nouns only? Does this procedure really do anything useful?

If all references were abbreviated to initials, e.g. A.I.N.R.A.P.(E) for the above quoted journal, only rarely would a second letter, as in Ca or Co, be necessary to avoid ambiguity. It is true that full abbreviations give a better description of the full name of a journal, but one has to consult a World List anyway to verify an unfamiliar journal. Even where one country has a number of journals there is rarely ambiguity if only the initials are used, and a second letter can easily be inserted to avoid these.

The practice of varying the number of journals per year is another source of error. For obvious reasons a society cannot standardize the size of each issue, but constant changing of the number of issues per year is confusing to all. Unless there is some good reason against it, there should be one volume number per year.

Other practices which might be standardized are the positions of the summaries and the tables of contents. The latter may appear on the front cover, the back cover, inside the front cover, inside the back cover, or hidden somewhere in the advertisements. Standardization, e.g. on the back cover, would greatly expedite the scanning of journals.

To librarians and all scientists who take a pride in their journals and keep them for future reference, the greatest nuisance is the variability in size. Most journals adopt a size roughly the same as that of this journal, which is convenient for use and can be accommodated in the ordinary library bookcase. One well-known British Society publishes three very good journals of an appreciably larger size, much too large for the ordinary bookcase. The inevitable result is that these journals are left about in stacks, get dirty and torn and are continually a problem in storage. If these journals were published in the normal size they could be stored in good condition in ordinary bookcases and the individual issues, becoming thicker, would not get torn so easily and would be more manageable on shelves. The usual answer to objections of this nature is that the larger size is more convenient for the printers. For whom are scientific journals intended—for printers or for scientists?

Forest Products Research Laboratory

Mr. Henry Wooldridge, O.B.E., B.Sc., A.K.C., has been appointed Director of the Forest Products Research Laboratory to succeed Dr. F. Y. Henderson, C.B.E. who retires next October.

Mr. Wooldridge, who has been a member of the F.P.R.L. Steering Committee since its formation, has spent most of his career at the Headquarters of the Department of Scientific and Industrial Research. In his present capacity as Head of Stations Division, he is responsible for Headquarters liaison with all the D.S.I.R. Laboratories, including the Forest Products Research Laboratory.

Previously, he was the Department's Deputy Establishment Officer and before that he served two Secretaries of the Department (Sir Frank Smith, G.C.B., G.B.E., F.R.S., and Sir Edward Appleton, G.B.E., K.C.B., F.R.S.) as Private Secretary.

Mr. Wooldridge, who is 51, joined D.S.I.R. in 1935 from the British Association for the Advancement of Science, of which he had been Assistant Secretary for five years.

Purity of Analytical Reagents

At an Ordinary Meeting of the Midlands Section of the Society for Analytical Chemistry a Discussion on 'The Purity of Analytical Reagents' was opened by J. T. Yardley, B.Sc., F.R.I.C. (Chief Analyst, Hopkin & Williams Ltd.)

The purity of available analytical reagents was discussed from several viewpoints and with special reference to the compilation of suitable purity specifications.

Prominent among the factors affecting the introduction of new specifications, and the revision of existing ones, is the increasing use of sensitive physical methods in certain specialized industries. From the suppliers' standpoint this situation poses many urgent problems other than purely preparative ones—most notably the packaging and storage of the reagents.

Highly specialized reagents, reference substances and volumetric standards promise to play increasingly important roles in the future and some typical examples were considered in detail.

LABORATORY APPARATUS AND MATERIALS EXHIBITION

Any firms having recently produced films emphasizing laboratory techniques and practices are invited to submit them to our Scientific Advisory Committee for consideration with a view to possible showing during the run of the above Exhibition. Film titles should be submitted in the first instance to: The Editor, Laboratory Practice, 9 Gough Square, Fleet Street, London, E.C.4.

LABORATORY EQUIPMENT TEST REPORT—No. 40

MAGNETICALLY AGITATED VAN SLYKE GAS ANALYSIS APPARATUS

Manufacturers: A. Gallenkamp & Co. Ltd., Sun Street, London, E.C.2.

Price: £58. 10s. 6d.

MAGNETIC stirring has been finding increasing application in the laboratory and it is logical that the familiar Van Slyke manometric gas analysis apparatus should be modernized with this innovation.

The apparatus by Gallenkamp incorporates all the essential features of the original Van Slyke design but some simplification has been achieved by the elimination of the oscillating motion. There are no belts or pulleys; instead there is a powerful horseshoe magnet mounted directly on the spindle of the motor which induces rotation of a small polythene-coated magnetic follower within the reaction pipette. As a result the troublesome flexible joint between pipette and manifold has been dispensed with, making dismantling and assembly very much easier.

The apparatus comprises the usual glass components mounted on a metal stand (Fig. 1). The glass pieces are all standard so that individual parts can be easily replaced. The mercury reservoir, water jacket, 10-40° C. thermometer and manometer—calibrated in millimetres to a height of 65 cm.—are all as on the mechanically-agitated version of the machine, but the glass manifold and reaction pipette have been slightly modified. The manifold has two standard ground glass cups which engage with appropriate ball fittings on the ends of the reaction pipette and manometer. The reaction pipette has been increased in diameter at its lower end to allow insertion and withdrawal of the magnetic follower and the large bulb has been altered in shape to eliminate the possibility of the stem becoming blocked by the follower when the mercury level is raised. The stand, consisting of a case mounted on a large tray fitted with four rubber feet, is made of rustproofed steel and pleasantly finished in white stoved enamel. It is just under 21 in. high, giving a low centre of gravity and therefore great stability. The tray has a drain hole near one corner for collection of spilt mercury and an efficient clamp to take the weight of the mercury in the vinyl tubing which connects the manifold with the reservoir. The case houses the induction motor and electrical connections and is fitted with adjustable plastic-lined clamps for holding the manifold; the adjustments on these clamps will satisfactorily accommodate the tolerance on the glass components. By simply slackening a bolt at the side of the case and sliding it within a slot, the height of the motor can be adjusted to induce optimal stirring. A stout stainless steel rod mounted to one side of the case supports the top of the manometer with an adjustable clamp, and is provided with two movable hooks for holding the mercury reservoir. As an optional extra, a self-winding clockwork time switch for the motor—with or without a buzzer—can be fitted into the case. This was supplied with the instrument on test and proved a great asset. It can be set for any time up to eight minutes by a natural clockwise turn.

The apparatus was put on trial in a busy clinical chemistry laboratory over a period of nine months and was used to determine the carbon dioxide capacity in just over 1,500 specimens of plasma. A few determinations of oxygen in whole blood were also carried out. The apparatus was used by ten persons ranging from graduates to junior technicians.

The construction proved to be sound, for the apparatus was functioning perfectly at the end of the trial. The electrical and metal parts and the enamel were all in excellent condition. The ground glass taps showed

Magnetically agitated Van Slyke gas analysis apparatus.

some evidence of wear but after such extensive use this was deemed to be reasonable. The etched graduation marks on the pipette lost their pigment and became difficult to see and it is felt that a more permanent means of marking the glass should be used at least at this site. The only part that required replacement during the trial was the pipette, which was fractured when the top tap became jammed as a result of inadequate lubrication.

The general impression of all who used the apparatus was very favourable. The features of the apparatus which were found particularly pleasing were the quietness of the motor, the convenience of the time switch and the relative ease with which the glassware could be dismantled for cleaning. The absence of a means of illuminating the manometer made reading of the height of the mercury column a little difficult at times when lighting was poor, but this can be overcome by correct siting of the instrument in the laboratory or appropriate artificial lighting, with or without the use of the optional manometer reader. It is felt more important to suggest that an attachment for mounting a lamp behind the pipette should be available for those intending to use the apparatus for whole blood analyses, as the dense pigment then makes the meniscus extremely difficult to see. It is also suggested that the appropriate Allen key and Phillips screwdriver be made available as accessories for the apparatus as most laboratories possess only ordinary screwdrivers.

The agitation of the reactants by the magnetic stirring was found to be highly efficient. The gases were extracted from plasma and whole blood in the standard times given by Peters and Van Slyke (1932) for the mechanically-shaken model. With optimal adjustment, mixing is in fact more violent than with the mechanical shaker and for gas determinations on whole blood it was found necessary to add a slightly larger volume of capryl alcohol than usual to avoid frothing. The adjustment of the height of the motor in relation to the volume of aqueous fluid in the pipette is critical; it must be such that the follower can be made to stir the reactants adequately without either stirring the mercury or leaping out of the solution. The most vigorous agitation is obtained when the motor height is so adjusted that the magnetic follower is induced to rotate in a vertical place. It is most important that the mercury should be below the level of the bulb during agitation even during the washing procedure, for if the surface of the mercury is agitated it is converted into a semi-solid sludge due to the formation of very fine globules which become dirty and fail to coalesce.

A preference for this apparatus over a mechanically-shaken model was universally expressed. The advantages of magnetic agitation as far as the operator is concerned are as follows.:

1. Noise and vibration are practically absent.
2. The risk of mercury and other dangerous chemicals being thrown out of the funnel of the reaction pipette during agitation is eliminated.
3. The funnel can be emptied or loaded while the reactants in the pipette are being agitated.
4. The junction between pipette and manifold is rigid and therefore less liable to leak.
5. The risk of fracturing the glassware is lessened as it is subjected to less strain during use and during stripping.

The results obtained with the apparatus under routine conditions were perfectly satisfactory. The absolute values found on a few specimens of known bicarbonate content were correct and in 20 experiments where the carbon dioxide capacity was determined with the machine on test as well as a model with mechanical shaking, the duplicates were all within 0·5 mEq/l. The order of reproducibility of the results was shown to be the same on the two machines.

Conclusion

The general impression of this apparatus is that the design and construction are very good and that the adaptation to magnetic stirring has been well executed. It offers important advantages over existing forms of the apparatus.

REFERENCE

Peters, J. P. and Van Slyke, D. D. (1932). Quantitative Clinical Chemistry Vol. 2. Williams & Wilkins, Baltimore.

Recent British Standards

Pentachlorophenol

Based on a draft specification of the Ministry of Defence, this new publication (B.S. 3175, price 3s.) specifies requirements for the form, purity, crystallizing point, matter insoluble in sodium hydroxide solution and total acidity of technical grade pentachlorophenol.

The material specified is used for imparting resistance to microbiological attack to materials such as wood and textiles.

Appendices to the nine-page standard deal with the determination of crystallizing point, matter insoluble in sodium hydroxide solution, and total acidity.

Thermographs (liquid-filled and vapour pressure types)

This new publication (B.S.3166, price 4s.) relates to liquid-filled and vapour pressure type thermographs for use within the temperature range —20° F. to 220° F. It covers service requirements for a distant reading thermograph, either as a wet and dry bulb hygrograph or as a twin (or single) dry bulb thermograph; and it is suitable for certain industrial and marine purposes.

When these instruments are used to determine relative humidity, reference to hygrometic tables or the use of a humidity slide rule is necessary; but when used as thermographs, readings are obtained directly from an appropriate chart. Information is provided about the characteristics of instruments of this type, together with suitable methods of construction and use; and the limits of error, temperature, compensation and time lag are specified.

Certification will normally be carried out by a recognized testing station, but details of suitable check tests are provided.

One of the three appendices to the standard provides a series of useful notes on packaging for despatch.

Copies of these Standards may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.

ORIGINAL CONTRIBUTIONS

THE CHOICE OF FLEXIBLE TUBING FOR USE IN A VACUUM SYSTEM

by A. T. J. Hayward, B.Sc.(Eng.)

Fluid Mechanics Division, National Engineering Laboratory, Department of Scientific and Industrial Research

When rubber or plastics tubing is used in a vacuum system at pressures below 1 mm. of mercury, it tends to 'outgas', i.e. to emit vapours which raise the pressure, just as if there were a leak in the system. Measurements were made of the outgassing rates under various conditions of eight samples of tubing, including neoprene, nylon, PVC and polythene tubing. Nylon was found to be the most satisfactory material and neoprene the least satisfactory.

Introduction

There are many laboratory processes in which several parts of a complex high-vacuum system have to be connected with tubing. Rigid connecting tubes made of glass or metal may be used, but it is often much more convenient to use flexible tubing made of an organic material such as rubber or plastics.

There is, however, a serious disadvantage attached to the use of tubing of this kind, in that all organic materials are liable to give rise to 'outgassing'. This is a term describing the progressive release of constituents from within the organic material which, although non-volatile at ordinary temperatures and pressures, evaporate at the very low pressures of the vacuum system. This emission of vapour inside the system has much the same effect as a leak in the walls, and many a newcomer to vacuum work, unaware of the existence of outgassing, has wasted hours searching for non-existent leaks.

One effect of outgassing is a reduction in the ultimate vacuum attainable with a given pump. Another effect occurs if plastics tubing is used to connect a vacuum gauge to the system whose pressure it is measuring, when outgassing can cause substantial errors in the measurements.

Sometimes a vacuum gauge is used to measure the pressure rise over a period of time in a closed system in which a chemical or physical change is taking place; in these circumstances outgassing in the tubing leading to the gauge is likely to create particularly serious errors. Assemblies of this kind, using pressures down to about 0·02 mm. of mercury, are used at the National Engineering Laboratory to study the release of dissolved air from oil. A study of the outgassing characteristics of various types of flexible tubing has, therefore, been made, and it is thought that the results may also interest workers with other kinds of vacuum apparatus.

Types of Tubing Tested

The following types of tubing in the small sizes suitable for laboratory purposes are readily available:

Natural rubber
Synthetic rubber (neoprene)
Plasticized polyvinyl chloride (PVC)
Polythene
Nylon, plasticized and unplasticized

Natural rubber is generally regarded as unsuitable for vacuum work, and a preliminary test showed that this reputation is justly deserved as its outgassing rate is more than four times as high as that of any other tubing tested. It was, therefore, omitted from the test programme.

A detailed investigation was made of the following eight types of tubing:

Neoprene.—One thick-walled tubing made especially for laboratory purposes.

Plasticized PVC.—Two typical thin-walled tubings 'A' and 'B', from two different manufacturers.

Polythene.—Two unplasticized polythene tubings from two different manufacturers; 'A', a thick-walled black tubing made for water supply lines, and 'B', a thin-walled opaque white tubing made for general laboratory purposes.

Unplasticized Nylon.—Two thin-walled tubings made from different nylons; 'A', a type 6-6/6-10 copolymer, and 'B', a type 6 nylon made from amino-caproic acid.

Plasticized Nylon.—One thin-walled tubing of type 11 nylon made from amino-undecanoic acid and plasticized with a proprietary plasticizer.

Method of Test

The tubing was all of approximately 5 mm. bore, and the exposed length (i.e. the length not counting the end connections) of each test piece was 2 ft. The wall thickness of the thin-walled tubing was approximately 1 mm., and of the thick-walled tubing approximately 5 mm. None of the tubing showed any signs of collapsing under vacuum.

A miniature McLeod gauge of the 'Vacustat' type was used to measure pressure rise under three different conditions of test, as shown in Fig. 1.

The first condition of test (Fig. 1a) was the most stringent. In this, one end of the tubing was connected

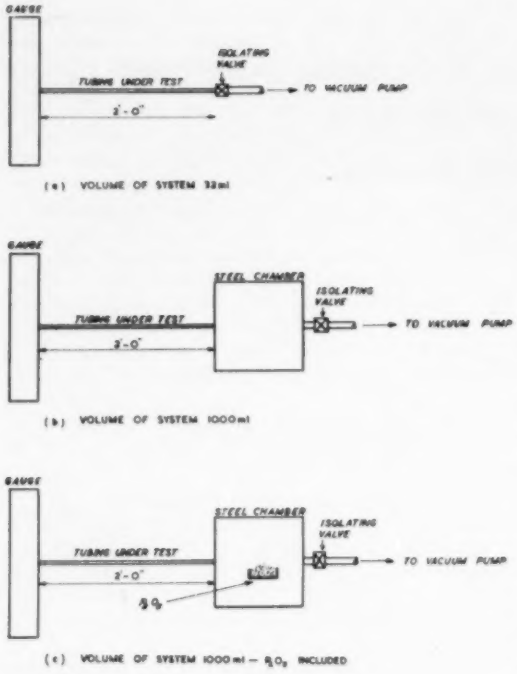

Fig. 1. Methods of testing.

to the gauge and the other end to an isolating valve. When the valve was closed the isolated volume was only 32 ml., so that outgassing caused a rapid pressure rise.

The second condition (Fig. 1b) simulates the circumstances often found in practice, where plastics tubing is used to connect a gauge to a vacuum chamber. The total isolated volume was 1,000 ml., so that the effect of outgassing was to cause a much less rapid pressure rise than in the first case.

The third condition (Fig. 1c) was the same as the second, except that a powerful dehydrating agent, phosphorus pentoxide, was included in the vacuum chamber. This absorbs any water vapour given off during outgassing, without absorbing any other vapours.

In each case the method of test was as follows. The system was connected through a valve to a rotary vacuum pump, and evacuated to as low a pressure as could be attained. This took between two and five minutes. Then the valve was closed, and the pressure gauge was read at frequent intervals. The results are exhibited as a graph of pressure against time, and the slope of this curve is a measure of the outgassing property of the tubing.

Preliminary tests with the isolating valve connected to the vacuum gauge by copper piping showed that there was no measureable leakage or outgassing arising from the valve.

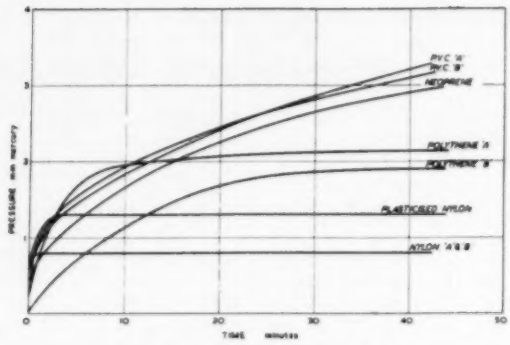

Fig. 2. Pressure rise in tubings alone.

Results

Pressure Rise in Tubing Alone.—The results of the first series of tests, where each tubing was connected as in Fig. 1(a), are shown in Fig. 2.

Under these conditions nylon is markedly superior, because it very rapidly reaches a steady condition at pressures in the region of 1 mm. of mercury. Polythene is the next best material; a steady pressure of about 2 mm. was reached after 20 or 30 minutes. Neoprene and PVC were very unsatisfactory, as the pressure showed no sign of levelling off even after 40 minutes.

Effect of Pumping Down.—It is sometimes suggested that outgassing can be eliminated by a preliminary 'pumping down', that is, by exposing the materials to vacuum for a period before commencing testing. All of the tubings were, therefore, pumped down by an air-ballasted pump for various periods and then re-tested. It was found that the nylon tubings were unaffected by the pumping down, and that in all the others there was only a limited improvement which was not sufficient to make them as good as the nylons. The magnitude of the improvement can be seen for a typical tubing (polythene 'B') in Fig. 3; the improvement is roughly proportional to the time spent in pumping down for the first hour, but longer periods of pumping down produced little further improvement.

The effect of pumping down is not lasting. It was

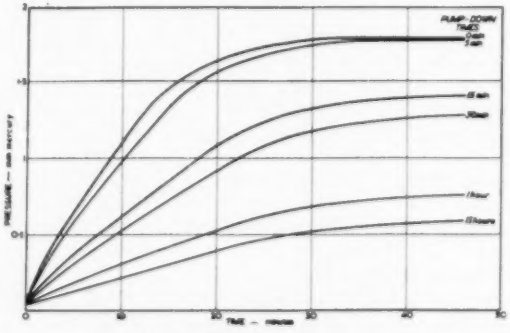

Fig. 3. Effect of pumping down.

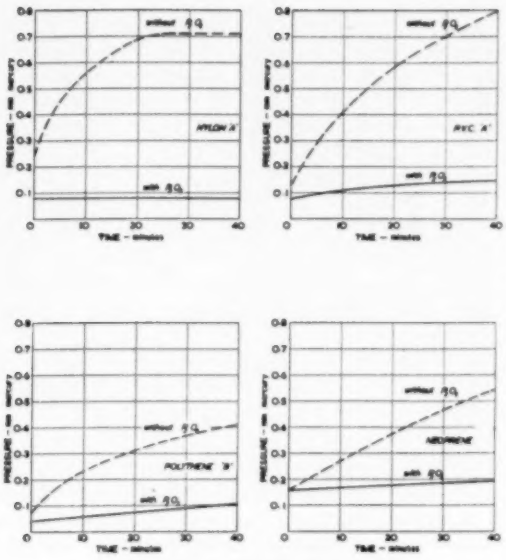

Fig. 4. Effect of dehydrating agent.

found that the tubings rapidly returned to their previous condition when taken off the pump and left exposed to atmosphere.

It is therefore evident that the pumping down process cannot be expected to solve the problem of outgassing.

Effect of Dehydrating Agent.—The results of comparative tests with and without phosphorus pentoxide in the vacuum chamber (Fig. 1c and 1b) are given in Fig. 4. The effect of including the phosphorus pentoxide is striking; with every tubing it reduced the pressure rise to less than a quarter of its former value. This shows that the principal constituent of the outgassing product of plastics tubing must be water vapour.

Comparison of Tubing under Dehydrated Conditions.—It follows from the preceding section that it is highly desirable for a powerful dehydrating agent to be included in the system whenever flexible tubing is to be used. The tests under dehydrated conditions (Fig. 1c) are, therefore, the most important as a basis for comparing the various types of tubing.

The results appear in Fig. 5. There are two criteria by which the results may be assessed:

1. The rate of pressure rise, indicated by the slope of the lines.

2. The ultimate vacuum attainable, which corresponds to the pressure when the isolating valve is closed (zero time).

The first criterion puts all three nylons in a class by themselves, since none of them showed any measureable pressure rise in one hour. Polythene 'A' was a good second best, since it produced only a small rise in the first two minutes and then no further rise. With every other material the pressure was still rising steadily after one hour.

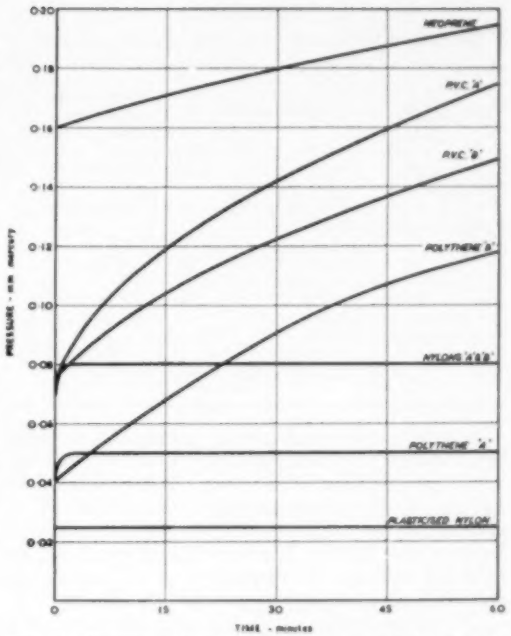

Fig. 5. Pressure rise with tubings connected to chamber containing P_2O_5.

The second criterion divides the materials into three groups:

1. The highest vacuums are attained with the three nylons and polythene 'A'.

2. The next best are the two samples of PVC and polythene 'B'.

3. The neoprene is considerably inferior.

The highest ultimate vacuum was attained with the plasticized nylon.

Discussion

For rough vacuum work outgassing may be unimportant, in which case the choice of flexible tubing will be governed largely by convenience. The usual method of making joints is to push the end of the flexible tubing on to a metal nipple with an outside diameter rather larger than the inside diameter of the tubing. This operation is very easy with a highly flexible material like neoprene, and moderately easy with plasticized PVC, but can be quite difficult with nylon and polythene. Where outgassing does not matter neoprene or PVC tubing is, therefore, the most suitable.

However, when precise measurement of vacuum pressure is necessary, and especially when pressures of 0·2 mm. of mercury or less are required, it is essential to reduce the effect of outgassing to a minimum.

To accomplish this it is necessary:

(*a*) to insert a powerful dehydrating agent in the system, and

(*b*) to select the most suitable type of tubing.

TABLE I

Comparison of outgassing behaviour of various tubings.

Condition of use	*Type of tubing*	*Relative merit based on outgassing behaviour*
Dehydrated system (i.e. with P_2O_5 inside the system	Nylons Black polythene White polythene PVC	Good Fairly good
	Neoprene	Fair
	Natural rubber	Poor
Natural system i.e. without dehydrating agent)	Nylon	Fairly good
	Polythene	Fair
	PVC Neoprene Natural rubber	Poor

Phosphorus pentoxide powder is the most powerful dehydrating agent available, and its use is, therefore recommended. It should be placed at the heart of the vacuum system close to the points of connection of the plastics tubing—not merely at the intake to the vacuum pump as is customary. In a very large system it may be necessary to have two or more trays of phosphorus pentoxide at strategic points within the system. Provided that the pentoxide is well sited and renewed when necessary it should reduce outgassing troubles by at least 75 per cent.

As a guide to the selection of the most suitable type of tubing, the various materials may be broadly assessed on the basis of the above tests, as shown in Table I.

All three types of nylon and the black polythene are t hus assessed as 'good' in a dehydrated system. Of these materials the plasticized nylon permitted a slightly higher ultimate vacuum than the others. This nylon is also rather more flexible than the other three 'good' materials and, hence, more convenient to use. Plasticized nylon has now been adopted for use in high vacuum systems in the Fluids Division of NEL.

Conclusions

1. The principal outgassing product of all the common types of flexible laboratory tubing when used in a high-vacuum system is water vapour.

2. By placing phosphorus pentoxide powder, a powerful dehydrating agent, at suitable points in the system, the pressure rise caused by outgassing from flexible tubing may be reduced by more than 75 per cent.

3. Nylon tubing had the lowest outgassing rates and is, therefore, adjudged the most suitable type of flexible tubing for precision work with high vacuum.

4. Neoprene tubing, although widely used for vacuum purposes, had worse outgassing properties than any material tested except natural rubber.

ACKNOWLEDGMENTS.—*The author is indebted to Mr. David Lawson for his assistance with the experimental work. This report is published by permission of the Director of the National Engineering Laboratory, Department of Scientific and Industrial Research.*

Radio-frequency Conductimetric Titration

by M. F. C. Ladd, M.Sc., F.R.I.C., and W. H. Lee, Ph.D.

Chemistry Department, Battersea College of Technology

Introduction

The use of conductimetric techniques in analytical chemistry is well established. Such methods generally use a conventional Wheatstone bridge, and an audio-frequency oscillator as the power source; rigidly-supported platinum electrodes are inserted into the solution, and the capacity between them (together with stray capacities in the circuit) is balanced out by an adjustable capacity across the variable arm of the bridge. Fig. 1 shows the circuit commonly used.

Recently the technique of radio-frequency titration, using the 'electrodeless' cell, has been introduced; Jensen and Parrack (1946) and Blake (1946, 1950) have described the early studies. The input frequency is raised from the audio- to the radio-range, and the electrodes are bands on the outside of a glass or ceramic cell; they are thus separated from the solution by the wall of the cell, Fig. 2(a). Alternatively, the cell may be inserted in the oscillator coil, so that the

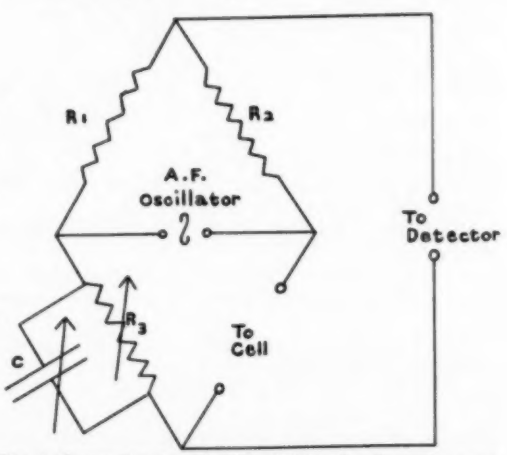

Fig. 1. Conventional conductivity bridge. R_1, R_2: ratio arms. R_3, C: variable resistor and capacitor.

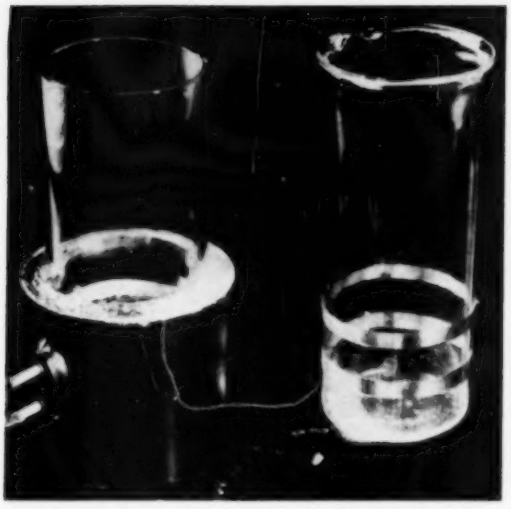

Fig. 2(a). The basic radio-frequency titration cell (right-hand cell). (b). The complete cell with the electrodes protected by a thermo-setting resin (left-hand cell).

electrodes are dispensed with—though with some reduction in sensitivity.

Considering the measuring circuit, there are considerable difficulties in the design and construction of conductivity bridges for operation at radio frequencies; the subject has been discussed by Hague (1943). It is much simpler, however, to cause a change in oscillator frequency or power by the inclusion of the conductivity cell in some part of the oscillatory circuit, and to follow this change throughout the course of the titration in the cell. The instrument readings are of course comparative and not absolute; this is however generally true of audio-frequency bridge measurements, because of the change in volume of the cell contents during the titration. The effect is reduced by having the titrant

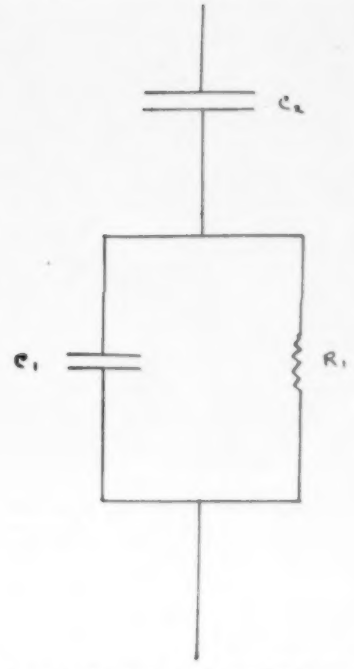

Fig. 3. Equivalent electrical circuit of the H.F. titration cell.

more concentrated (usually about × 10) than the solution in the cell, a procedure also adopted in radio-frequency titration.

Advantages

A simple apparatus such as that described is much less expensive than the resistance- and capacitance-boxes which form the Wheatstone bridge. A special conductivity cell is not required—copper bands round a

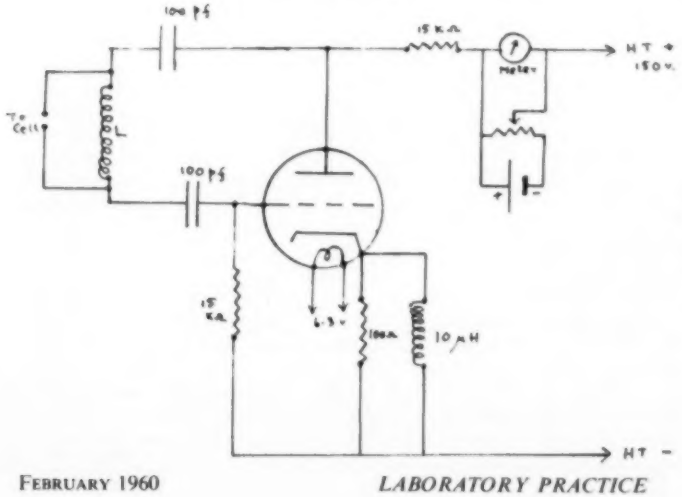

Fig. 4. Basic circuit of oscillator. L: switched inductors for change of frequency.

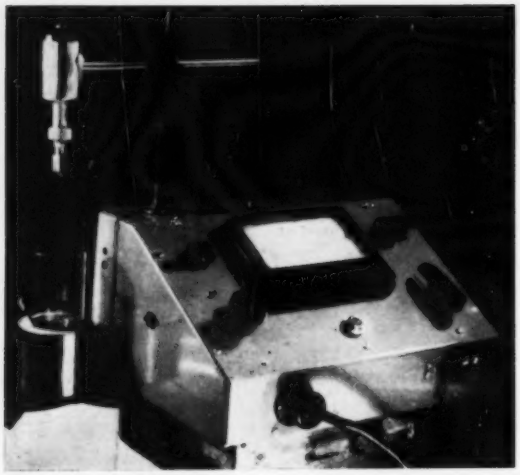

Fig. 5. The complete radio-frequency titration apparatus.

thin-walled glass beaker are adequate for most purposes. The electrodes are outside the cell, so that precipitation cannot affect their area. An important factor is that changes which affect the dielectric constant, but leave the conductivity practically unchanged, such as the addition of water to alcohol, or the variation in isomeric composition of xylene, may be readily followed (Burkhalter, 1952).

These advantages can only be obtained by operating at radio-frequencies. The equivalent electrical circuit of the titration cell is shown in Fig. 3, where C_1 and R_1 are the capacitance and resistance for the path between the electrodes through the solution, and C_2 is the corresponding path through the cell wall. The resistance path through the wall may be neglected, because it corresponds to a practically infinite resistance in parallel with C_2. For changes in C_1 or R_1 to affect the oscillator, C_2 must offer a low-impedance path to the oscillatory current. Suppose C_2 to be 50$\mu\mu$f. capacity; at 1,000 cycles/sec. the impedance of C_2 is about 3 megohms, which falls to 300 ohms at 10 megacycles/sec. Hence only at such frequencies is the C_1R_1 combination effectively coupled to the oscillator.

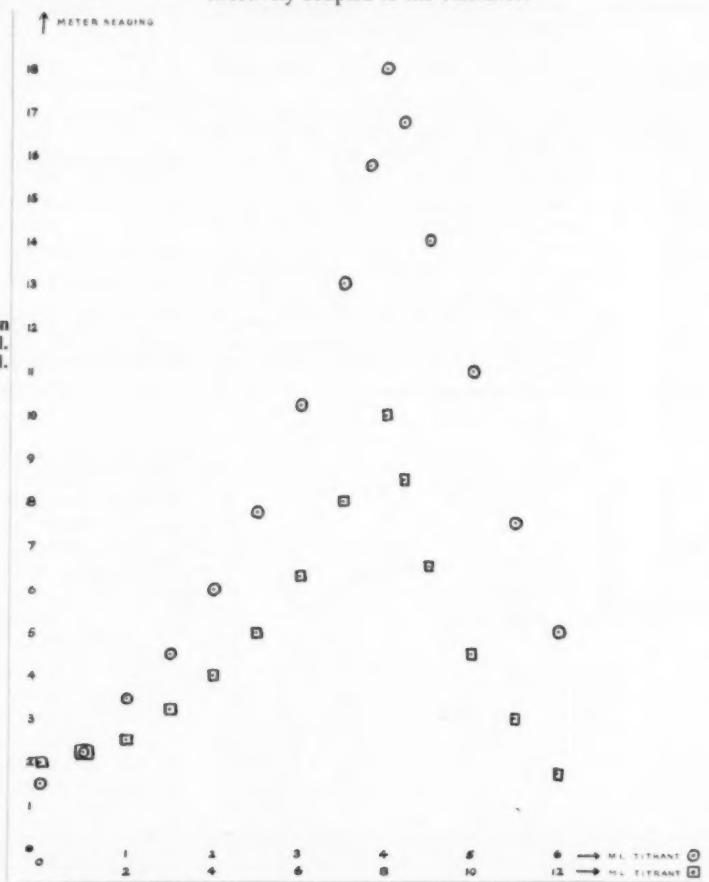

Fig. 6. Effect of concentration upon sensitivity. ○ N/100 NaOH v. N/40 HCl. □ N/20 NaOH v N/16 HCl. 10 ml. NaOH was used in each titration.

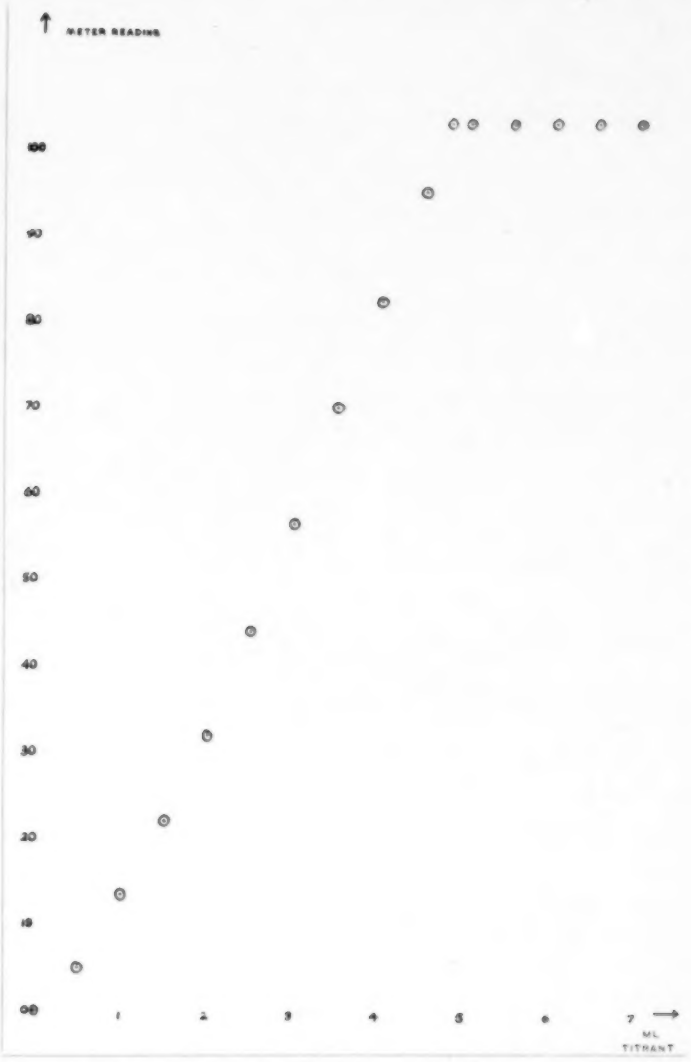

Fig. 7. 5 ml. N/100 $MgSO_4$ v. ≈ N/100 $BaCl_2$ in 50 per cent EtoH/H_2O medium.

Many different circuits, and a wide range of frequencies, have been investigated. Apparatus ranges from simple single-valve circuits (Hall *et al.* 1954) to an assembly of standard electronic test equipment (Hall and Gibson, 1951). Very high frequencies (up to 250 megacycles/sec. (Lane, 1957)) have been used to improve the sensitivity at high ionic concentration, but require very careful screening.

Apparatus

The basic circuit (Fig. 4.) consists of a Clapp oscillator (Clapp, 1948) using one half of a 6J5 as a triode; the H.T. is supplied from a stabilized unit, through a microammeter. The meter is used to register small changes in, rather than total, anode current by applying an adjustable backing-off voltage, which is also derived from a stabilized source. The initial meter-reading may thus be brought to zero, or to any convenient position on the meter scale. The sensitivity of the meter is controlled by a variable shunt, so that either the whole titration, or that portion of it near to the equivalence point may be made to occupy the full scale.

No single frequency appears equally satisfactory for all investigations, and the present instrument has three switched frequencies, of approximately 10, 20 and 30 megacycles/sec. The cell consists of a thin-walled Pyrex glass cylinder, diameter about 5 cm. and length 12 cm., with silver band electrodes 6 mm. wide, spaced 2·5 cm. apart, round the outside; the electrodes are protected by embedding in a suitable resin (Fig. 2(b)). The cell plugs in to a socket, and is coupled by condensers CC′ to the anode coil.

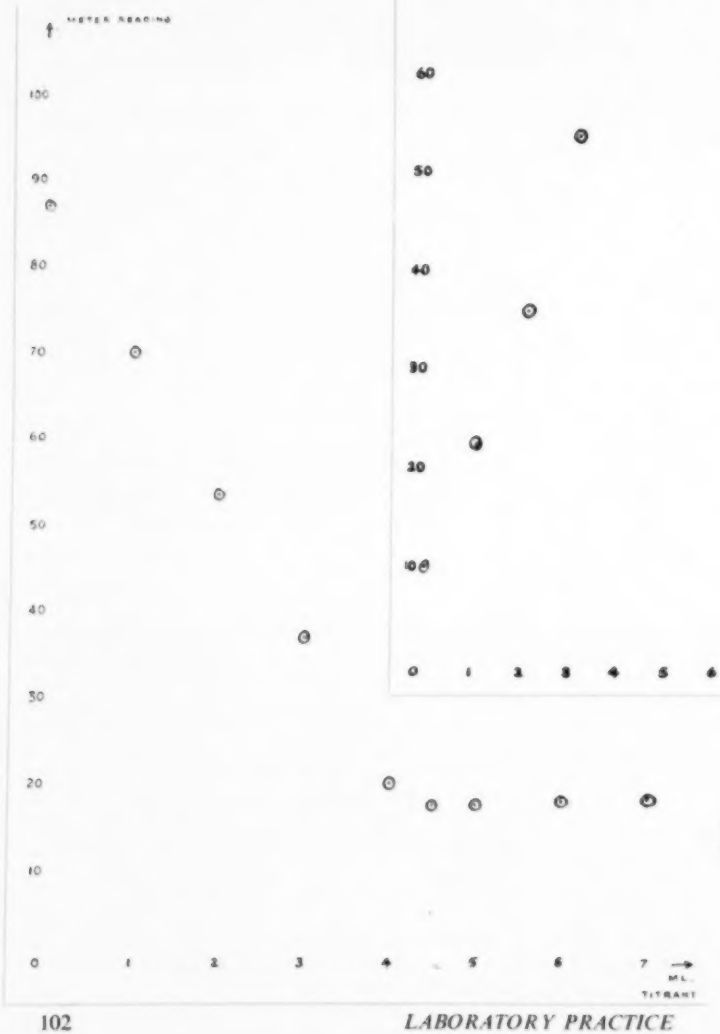

Fig. 8. 100 ml. N/1000 $AgNO_3$ v. ≈ N/50 HCl in aqueous solution.

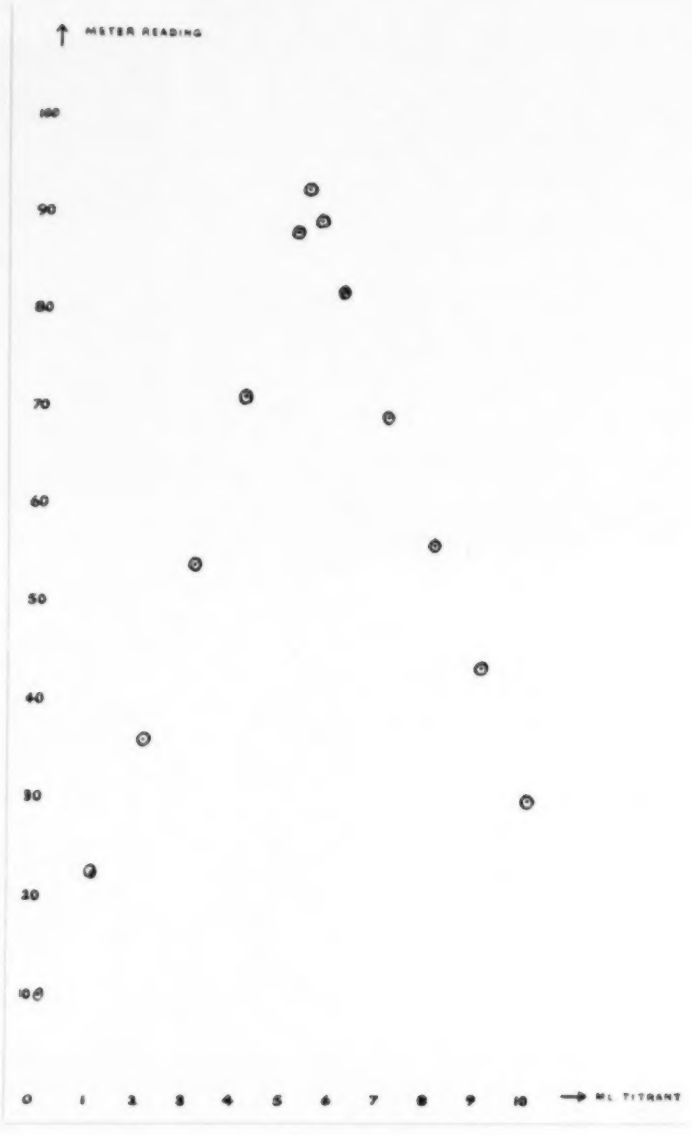

Fig. 9. Titration of 4 ml. N/10 ferrous ethylene diamine sulphate in N/5 H_2SO_4 with ≈ N/10 $K_2Cr_2O_7$.

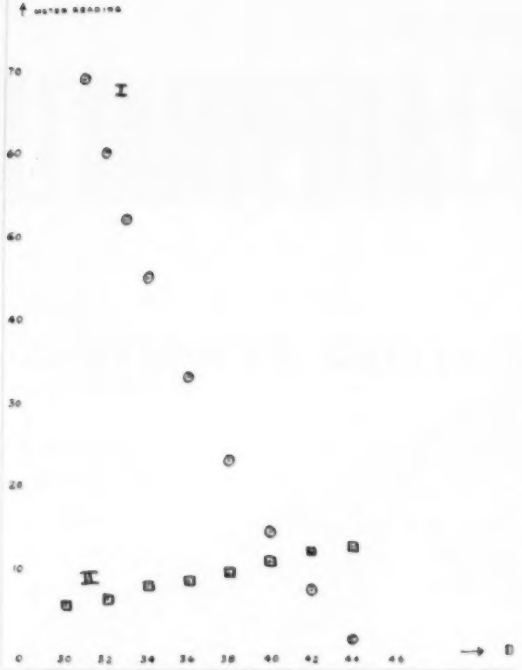

Fig. 10. Variation of anode current (I) and grid current (II) with change in dielectric constant (D). EtoH H_2O mixtures.

As an alternative to the anode-current meter, a grid-current meter, connected at G, may be used; this is also a microammeter, but requires no backing-off circuit, since grid current is very small. In general, this modification is less sensitive than the original circuit.

Neon-tube H.T. stabilization has proved satisfactory in our investigations, but in an industrial laboratory, where greater fluctuations in mains voltage might be expected, hard-valve stabilizing would be advantageous. The complete apparatus is shown in Fig. 5.

Results

Some typical titration curves, of meter reading against volume of titrant added, are reproduced below.

In acid-base titrations optimum sensitivity occurs at a concentration of about 0·01 normal, for the solution in the cell (Fig. 6). In the precipitation of a neutral sulphate solution with barium chloride reagent, addition of up to 50 per cent by volume of ethyl alcohol to the cell speeds up the attainment of equilibrium (and hence of a steady meter reading) during the titration (Fig. 7). This is not required in the precipitation of halide-ion solutions with silver nitrate reagent (Fig. 8).

The oxidation of ferrous ions by potassium dichromate in acid solution by this technique does not appear to have been previously reported. Although the total ionic concentration is high, mainly due to the dilute acid added, accuracy and reproducibility are satisfactory (Fig. 9).

The effect of change of frequency upon the shape of the titration curves is shown in Fig. 10. It is interesting that at all three frequencies, phosphoric acid behaves as a monobasic acid.

The effect of dielectric constant change upon meter-readings of both anode and grid currents is illustrated in Fig. 11; the dielectric constant of ethyl alcohol-water mixtures is plotted along the X-axis. The range could be extended, but there is a reduction in sensitivity beyond this region.

The high-frequency titrimeter is thus seen to be a versatile addition to the range of laboratory and control instruments. Reference should be made to analytical chemistry journals since 1950 (particularly 'Analytical Chemistry') for details of the numerous investigations in which it has been used. Commercial instruments are available in America and in Germany, but not as yet in this country.

ACKNOWLEDGMENT.—*We are indebted to Polymer Consultants Ltd., 3-4 Fox Court, Gray's Inn Road, London, E.C.1, for interest and assistance in this work.*

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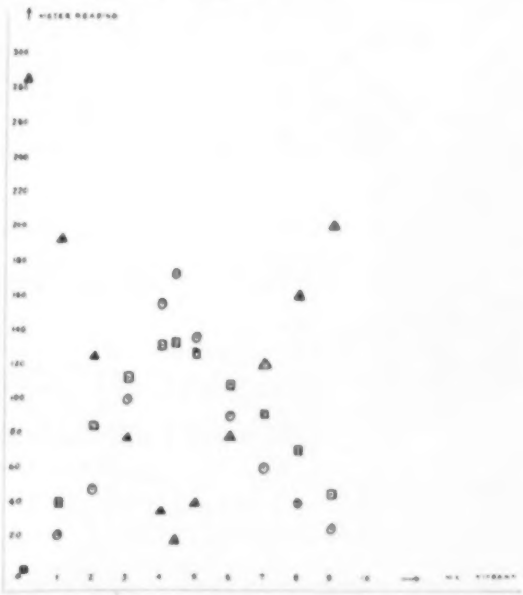

Fig. 11. Effect of change of frequency upon the shape of the titration curve. 5 ml. N/5 H_3PO_4 v. ≈ N/5 NaOH. ○ = 10Mc/s. □ = 20 Mc/s. △ = 30 Mc/s.

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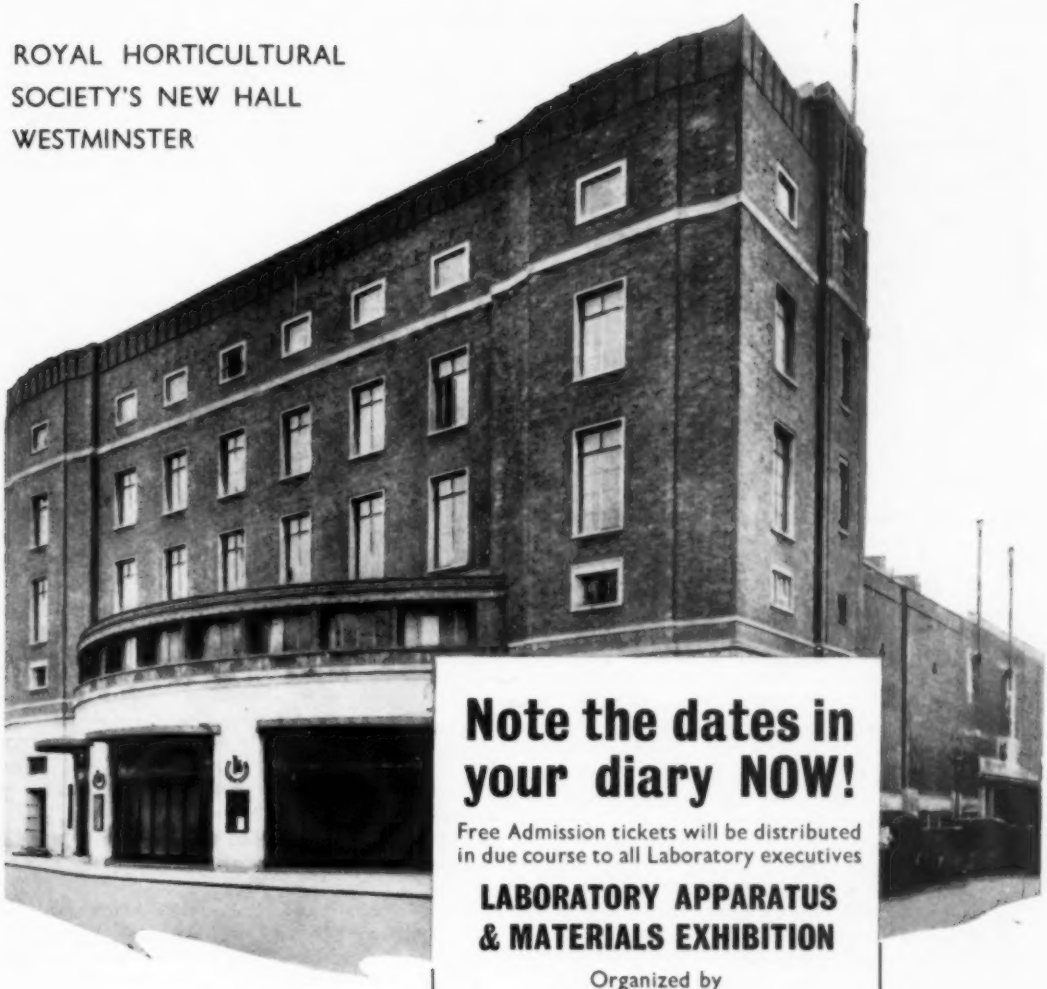

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ARTICLES

THEORY AND PRACTICE IN THE PHYSICAL CHEMISTRY LABORATORY

by S. Lewin, M.Sc., Ph.D.

Physical Biochemistry Research School, South-West Essex College of Technology, London, E.17

PART III—EXAMINATIONS

A PRACTICAL examination is invariably held in inorganic and organic chemistry courses leading to higher qualifications. This is not the case in physical chemistry where a practical examination is held only in some courses. Thus, in the B.Sc. (External) of London University and the Grad. R.I.C. practical inorganic and organic chemistry examinations are held, but practical physical chemistry is ignored. One might well pose the question why this distinction should exist, or still better whether it is right. It is convenient to start at some earlier stage and consider the problem of holding any examinations and particularly practical examinations.

The examination system is very old. Its origin may be attributed to the need for some test which can measure the knowledge and ability of the student. It has also been used as a selective system for reducing the number of candidates suitable for a particular appointment. The system is, of course, influential in another, but nevertheless related, field, viz. that of encouraging the student to greater exertion in his studies. As is generally appreciated, considerable attractions exist in a college which tend to distract the student from his studies. Student Union activities—including wine, women and song—have long played their part and now motoring, wireless, television and other attractions contribute their share. Naturally, ways and means of combatting this negative influence should be favourably considered. Among the major forces driving a student to study are genuine interest in the field of study, ambition to obtain a qualification which is likely to result in a higher status associated with a corresponding monetary award, and fear of failure. The examination system and associated possibility of failure no doubt 'encourage' a student to pay more attention to his studies. Correspondingly, failure to hold an examination results in tendency towards slackness. The student tends to skip the examination-less practical courses and excuses himself by pleading that the practical is not as important as the theory. Emphasis to the student that the practical is important helps only a little. The *average* student considers only what he *wants*, not what he *needs*. He wants to pass, or do well, in the examination with the *least effort*; and if a practical examination is not to be held, then he feels himself justified in paying smaller attention to the practical than to the theory where an examination is to be held. He feels that the arguments in favour of treating theory and practice equally sound very much like the attitude of: 'Do as I tell you, don't do as I do'. The slack attitude is often backed by 'understanding' or 'sympathetic' teachers, who therefore neglect their duty so much that they not only fail to *educate* their students, but also even to *train* them in the practical aspects of the subject. In the chemical field—when no practical physical chemistry examination is held—the result is that the student may obtain his qualification without a sufficient background in practical physical chemistry. If he is one of those few who fulfil George Bernard Shaw's saying: 'He who can, does; and he who can't, teaches', he perpetuates the legend that practical physical chemistry does not matter. From this aspect alone it is a serious mistake not to enforce a practical physical chemistry examination as part of the final examinations. There are other valid reasons, particularly those based on the needs of modern developments, as to why a practical physical chemistry examination should be held. Some will be considered later. At this stage one might even pose the critical question whether the present form of, and training towards, the practical inorganic chemistry examination fulfils the requirements of *teaching* of inorganic chemistry in the sense that it involves *correlation* of theoretical principles and practical experience. If we accept the axiom that teaching institutions should *educate* science students to appreciate, correlate and apply scientific principles, then the practical periods devoted to qualitative and quantitative analysis—provided that the theoretical principles are made the basis of the teaching—are used correctly. If the subsequent practical examination is arranged to cover this ground, which is educationally sound, then it fulfils its correct function. However, too often one finds that the student is taught qualitative and quantitative analysis from the standpoint of practical details rather than that of correlation of theory and practice. This is well illustrated by those textbooks in which the author states that the book has been written specifically for the student 'on the bench'—little correlation of the above is to be found in the book. Indeed, the student's attitude—and this encouraged by a number of teachers of inorganic chemistry—is to analyse as many 'spots' as possible to acquire the necessary 'practice'. The student therefore spends a ridiculously large proportion of the time in the course on *repeated* attempts to acquire 'proficiency' in

analysis of mixtures. This happened 50 years ago and is still happening nowadays despite the considerable expansion of the horizons of chemical analysis, e.g. in paper chromatography and polarography which could well be used in practical examinations in inorganic chemistry. However, we may hope that a more modern attitude will come about with time. After all, there still exist teachers of chemistry who mourn the passing of the ancient Phlogiston Theory, but their numbers are steadily declining!

Returning to the question as to why a practical examination should be held in physical chemistry, it should be pointed out to those who believe that qualitative and quantitative inorganic analysis (as taught at present) requires a good third, if not more, of the time devoted to the practicals, that modern developments in electronic instrumentation have resulted in chemical analysis being carried out to very accurate limits by physical techniques far easier than those involved in the classical methods of gravimetric analysis. There is a school of thought that decries the *extensive* use of electronic instruments during the teaching of the practical subjects. The reasons given are that their extensive use is likely to take too much time away from that which should be devoted to gravimetric and similar analyses, and particularly that the student tends to use such instruments as a series of 'black boxes of tricks' without understanding how they work, their use therefore contravening the principles of scientific education. The answer to the first objection is that far too much time is being devoted at present to gravimetric analysis in view of the tremendous expansion of physio-chemical analysis in other ways. The second objection deserves serious consideration, because automatic use of a machine without understanding its *modus operandi* is educationally undesirable. However, provided that electronic and transistor instrumentation is taught properly (preferably within the physical chemistry course) so that the student understands what is going on inside the so-called 'box of tricks', then the increased accuracy and increased range of operation as well as the tremendous saving of time attainable by the use of such instruments more than justifies their *extensive* use during the practical physical and other chemistry periods used for qualifications such as B.Sc. and Grad. R.I.C. Persons who still feel that such instruments are too 'advanced' for extensive use in the courses should consider a parallel example in the *regular* use of a calculating tool such as a slide rule or a calculating machine instead of the cumbersome arithmetical or logarithmic table computations. Surely they would agree that their use is justifiable!

The acceptance of extensive application of physico-chemical methods, particularly those involved in electronic instrumentation, makes it necessary that the student be familiar with their principles and *modus operandi*. In turn a practical examination involving their uses should be held so as to encourage the student to understand their uses and limitations. Assuming then that a practical physical chemistry examination is to be held, it is desirable to utilize the opportunity to consider whether the system of a practical examination could not be carried out in a more suitable way than that practised at present. The ideal examination paper should be designed so as to test not only the student's knowledge but also his critical powers in dealing with present techniques as well as his ability to deal with new problems. However, the present practical examinations are set out so as to assess the ability of the student to follow a certain *pattern* of tests, e.g. the qualitative analysis tables, concentration and endpoint-determinations and associated calculations for the evaluation of certain constants. Such examinations most certainly do not meet the ideal requirements noted above.

A further requirement which is not met in the present type of practical papers is that of technical writing; it is of fundamental importance that the student be proficient in expressing himself correctly, in describing a specified experiment, explaining the uses and practical limitations of a given project and expounding new projects. Ways and means of educating students in this field will be considered in other publications. Here, however, we are concerned with the use of the examination system for assessing such ability as well as encouraging the student to develop his powers by inclusion of special questions in the examination. Some consider that this section should be part of the *theoretical* examination, and there is something to be said for this point of view. However, there are problems concerned specifically with practical details and these could well be included in an overall practical examination.

To fulfil these requirements it is advocated that the practical examination in physical chemistry should be taken in the following parts:

A. A *written* paper concerned with *practical* details involved in present or possible future problems or projects. The following could be included:
   1. The description of a practical experiment for the *demonstration* of a particular phenomenon or property with emphasis on the precautions required to make the experiment a success, e.g. the electrophoresis of a given sol.
   2. Comparison and contrast of two methods or techniques in the tackling of a specified *investigation*, e.g. the study of a suitable complex ion formation by a distribution method or by spectrophotometric analysis.
   3. Criticism of the experimental details utilized in a described investigation or experiment.

B. A short practical examination designed to assess the student's understanding and manipulation of electronic instruments used in tackling chemical problems.

   The following could be included:

   The assembling of a pH meter from simple components; the repair or building of a thermostatic system involving an electronic relay; or the assembling of a power pack for a constant voltage or/and constant current supply, such as used in electrophoresis experiments.

C. A practical paper on physico-chemical problems, of the type used in some colleges at present.

One often hears the excuse that it is not possible to set up this last examination because the available equipment is insufficient to permit the setting of the same question to the comparatively large number of students expected to take the examination. For example, the determination of the pK value of a given acid requires the use of a potentiometric hydrogen electrode set-up or a pH meter. As is well known, such apparatus is in comparatively short supply and is used in rotation by students and consequently at any given time only a fraction of the student body can use it at any one time. But must the same problem be given simultaneously to *all* the students? Surely, it is possible to follow the procedure in practical physics, setting a number of different experiments and letting the students draw their experiments by lot. Considering a group of 16 students who are to take the examination the following practical problems can be duplicated thus:

1 and 2. The determination of the pK value of an unknown acid using a hydrogen electrode.
3 and 4. The determination of the pK value of a given acid using a pH meter.
5 and 6. Determination of the order of a given reaction.
7 and 8. Determination of the number of molecules of ammonia combined with an unknown metal cation.
9 and 10. Determination of the absorptive power of a given adsorbent.
11 and 12. Determination—and comparison—of the concentration of Cu^{++} in a given solution using volumetric and colorimetric methods.
13 and 14. Determination of the surface tension of a given solution by both the ring and capillary methods.
15 and 16. A conductivity or transport number assessment.

Even a small teaching physical chemistry laboratory should possess sufficient equipment to carry out the above work.

One further point deserves consideration in the assessment of a student's status for scientific purposes. In those examinations where different grades are issued the present system is to sum up all the marks obtained, independently of the type of question answered, and to issue the grading on the basis of the percentage obtained. This applies even in the lower type of examination such as the Advanced Level of the General Certificate of Education where the overall percentage mark is a sum total based on the percentage marks obtained in the various questions. However, some of the set questions required mere knowledge, while others required intelligence and discriminative or mathematical ability. The choice available is usually such that its weighting could be due in large measure to sheer knowledge and not to the other far more important factors. The overall percentage mark may therefore be misleading when a student's suitability is gauged for a purpose which requires considerable discrimination or planning ability rather than sheer massive memory. For example, most regulations require a student to have at least an Upper Second Class Degree in order that a suitable stipend may be awarded. This condition is based on the assumption that such students are likely to succeed, while those who obtain only a Pass Degree are not. The writer has known a number of Upper Second Class students who have proved worse than useless in either research or in posts where intelligent discrimination and simple planning were necessary, while students with a Pass Degree have been quite successful in similar posts. The latter result was due partly to ability, which the particular examination did not correctly assess, and partly to determination to make good which, *by present examination methods*, is unassessable. This last factor will be discussed in other publications. However, in view of the above considerations it is advocated that the certificate of the overall qualification should include the percentage marks obtained for different student qualities and knowledge. This can be simplified if *separate* papers be given for assessment of the various factors mentioned. Thus, in the practical physical chemistry examination certificate, the percentage marks obtained for the first paper, the paper on electronic instrumentation and the usual practical paper, should be specified on the overall Degree Certificate. This might involve a considerable amount of administrative work. However, by enabling a more accurate assessment of the student's abilities, the system would help to reduce the number of misfits and associated unhappiness and economic waste in the scientific field.

Vacuum Science and Technology

Following The Institute of Physics' London Conference on high vacua held in April last, various suggestions were made for arranging regular British meetings on vacuum science and technology, and for British participation in international conferences in this field.

As a result of informal discussions between societies and institutes in this country a 'Joint British Committee for Vacuum Science and Technology' has now been formed. The committee consists of representatives from each of the following bodies:

The Institute of Biology
The Institution of Chemical Engineers
The Royal Institute of Chemistry
The Institution of Electrical Engineers
The Iron and Steel Institute
The Institution of Mechanical Engineers
The Institute of Metals
The Institute of Petroleum
The Physical Society
The Institute of Physics.

Its objects are:

(*a*) To co-ordinate and help to initiate meetings in the whole field of vacuum science and technology arranged by constituent bodies.
(*b*) To act in the collective interest of the constituent bodies by maintaining liaison with the International Organization for Vacuum Science and Technology and with national vacuum societies, and otherwise.

The Institute of Physics has agreed to provide the secretariat for the joint committee; communications should be addressed to:

The Secretary of the Joint British Committee,
47 Belgrave Square, S.W.1.

The Use of a Simple Drop Counter in Studying Gastric Physiology

by C. J. Lockett

Department of Surgery, University of Natal, Durban

DROP counters have been previously designed for laboratory work but a modification is described here which is a simple inexpensive all-purpose drop rate recorder and which has proved to be of value.

Description of Instrument

The circuit is so designed that drops of secretion flow across two platinum wire electrodes (B, Fig. 1) reducing the output of the 6V6 to near cut-off and thus momentarily de-energizing the electromagnetic coil of the post office counter and the kymograph pen marker. These are connected to output A in series. A further visual indication of the operation is given by the panel lamp which flicks on and off as the drops fall. An optional modification which can be made for a small cost is the replacement of the two R.M.I. rectifiers, by a valve rectifier and a transformer.

A 6 volt tapping can be used for a time base line marker (this consists of a magnetic pen marker and push button switch which marks the drum at specific intervals as shown in Fig. 2, bottom line).

Grid current, i.e. current across electrodes, is in the region of a few micro-amps and therefore electrolysis is virtually non-existent.

Two types of electrodes of simple construction are shown, consisting of a piece of Perspex with two wire electrodes and a hole drilled down the middle for compressed air (Fig. 3). The compressed air gently

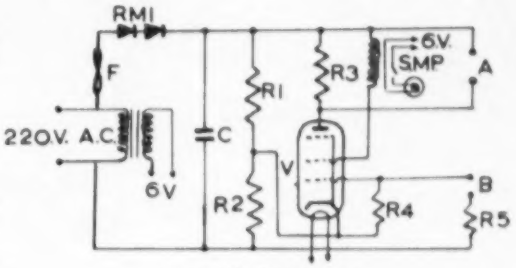


Fig. 1. Circuit diagram.

blows the drops that fall from the glass tube above off the wire electrodes as shown. The more complex electrode stand was made to accommodate test tubes which could be changed every 15 minutes.

The apparatus is in use for recording gastric secretion from a two pouch dog (Heidenhain and antrum pouches, Fig. 4 and 5).

A rubber tube is attached to the metal cannula and to the glass Y-piece of the drop counter electrode head.

Compressed air through a reduction valve is allowed to flow through the Y-piece gently blowing the drops off into the Perspex funnel, and over the wire electrodes. These are then counted and recorded by a pen marker and numerically by a post office magnetic counter giving the number of drops per minute. This is particu-

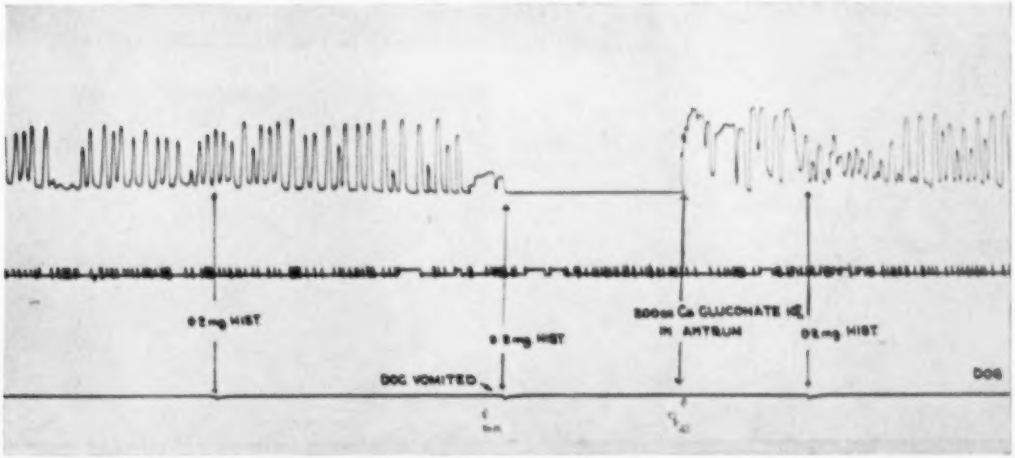
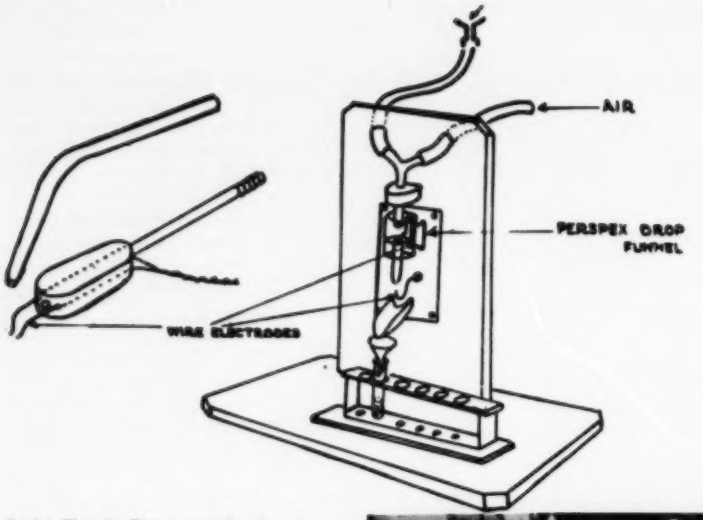
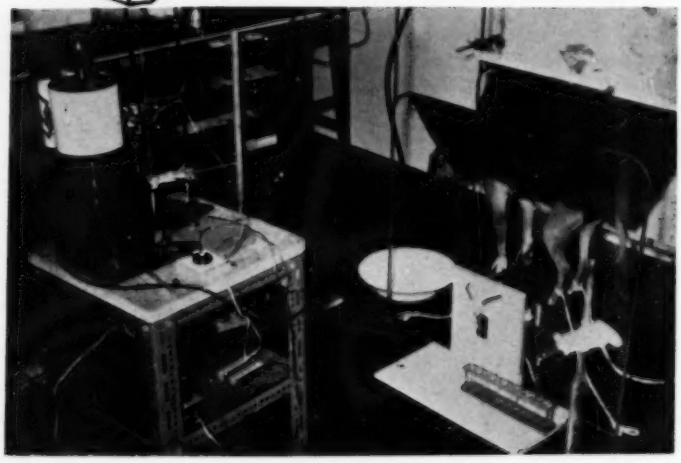


Fig. 2. Experimental tracing.

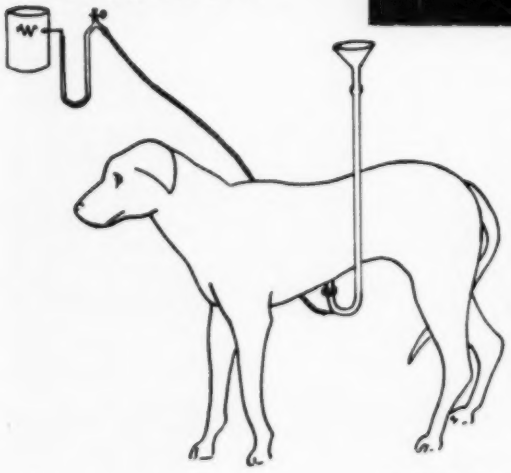


Left: **Fig. 3. Electrodes.**

Right: **Fig. 4. Drop recorder in use during experiment.**



Below: **Fig. 5. Apparatus in use for recording gastric secretion.**



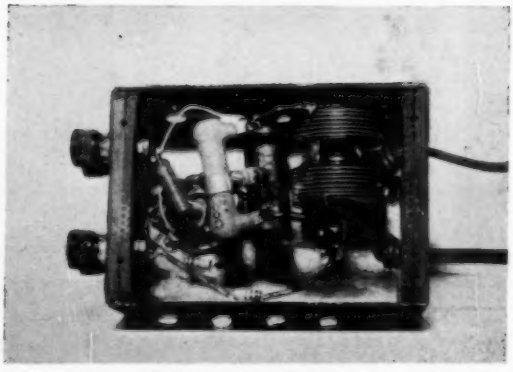


Fig. 6. Drop recorder.

Fig. 7. Drop recorder.

larly valuable for noting the rate of flow immediately before and after parenteral or intravenous drug administration.

The drops fall on to a Perspex trough and from there into a test tube which is changed every 15 minutes or other chosen time. The tubes containing the secretion are removed for analysis.

Contractions of the antrum are recorded on the same drum with a water manometer coupled as shown in Fig. 5.

The speed of the drop counting mechanism is governed by the mechanical features of the P.O.M.C., some counters functioning well at rates of 180 to 240 p.m.

Fig. 6 and 7 show the two types of drop counter, Fig. 6 being the simple one and Fig. 7 illustrating a slightly more expensive type with a valve rectifier and transformer.

Fig. 2 illustrates an actual experimental recording.

PARTS LIST

Two R.M.I. plate rectifiers 110 volts each 75 m.a.
C = 8μF condenser
V = 6V6—GT Valve.
R_1 = 10K Ohms resistor (10w.).
R_2 = 2K Ohms resistor (10w.).
R_3 = 100K (1w.).
R_4 = 10 Meg. Ohms ($\frac{1}{2}$w.).
R_5 = 2·2 Meg. Ohm ($\frac{1}{4}$w.).
S.M.P. = Sieman miniature high speed relay and 6 volt panel lamp.
A = Output to electromagnetic signal marker, 1,000 Ohms minimum.
B = Drop counter electrodes.

The circuit was designed during the tenure of a grant made available by the National Cancer Association of South Africa to the Department of Surgery, University of Natal.

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Apparatus for Routine Analysis

by G. Lindley

Works Chemical Laboratory,
English Electric Co., Ltd., Bradford

PART III—AUTOMATIC MEASURES

Introduction

In routine work, where large numbers of reagent additions have to be made into beakers, flasks, etc., graduated cylinders are usually used where such accuracy is permissible. This type of operation is very common, e.g. the addition of solvent acids to metallurgical samples, etc. Several types of apparatus are available to facilitate this work, but those which have been tried show some serious disadvantages. The normal type of gravity-feed automatic pipette gives trouble due to leakage and 'popping' of the stopcock as a result of the liquid head. Also large capacity stock bottles are difficult to lift on to the necessary shelving. Tilt measures and Squeeze-bottle measures are limited in stock capacity by hand spread. The apparatus described below shows none of these disadvantages and enables deliveries to be made rapidly and conveniently.

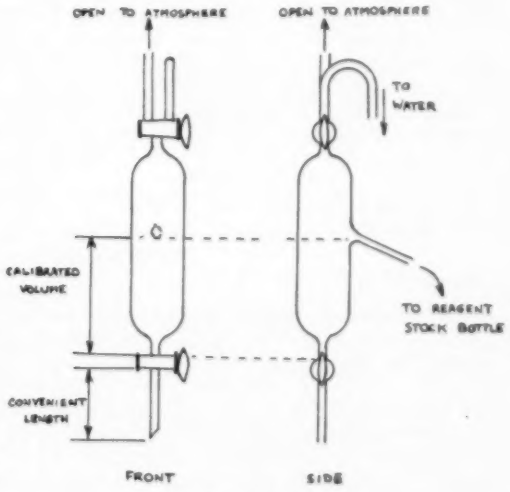

Fig. 1. Automatic measure.

Description

The design of these measures is self-explanatory from Fig. 1. One branch of the upper double oblique bore stopcock is connected by pressure tubing to a water vacuum pump, the other branch being open to atmosphere. Suitable tubing (e.g. polythene) is used to connect the side arm to the stock bottle. In this laboratory several of these measures are mounted on a board, and a single water pump serves all the measures as the stopcock selectively operates each unit independently of the others. For operation, the bottom stopcock is first closed, then the upper stopcock is turned to connect to the water pump. Reagent is rapidly drawn into the measure *via* the side-arm, and as soon as this is covered, the stopcock is turned to atmosphere. Excess reagent now runs back into the stock bottle and the measured volume is ready for delivery *via* the bottom stopcock. The stock bottles of 5 litre capacity are located in the cupboard under the bench, as shown in Fig. 2, the polythene tubing being brought through holes at the back of the bench. The unit thus occupies no working bench space.

Measures of volume between 20 ml. and 100 ml. capacity are in use in the laboratory and the maximum error of delivery is $\pm$ 1 per cent. This is well within the limits of this type of measurement and reproducibility is better than when using graduated cylinders.

These measures are now available from Ralph Cuthbert Ltd., Westgate, Huddersfield.

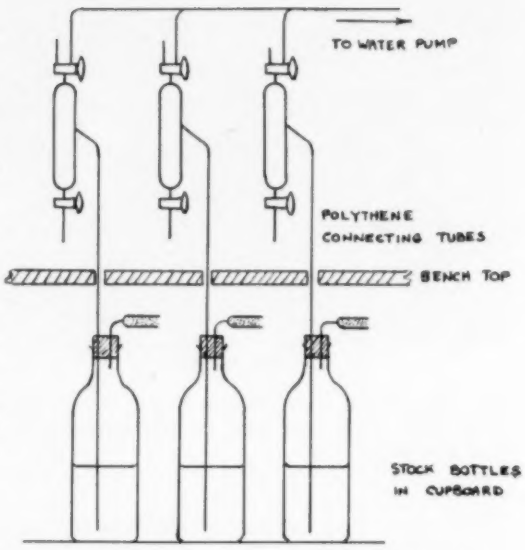

Fig. 2. Schematic set-up of automatic measures.

Applications

A feature of these measures is their rapid and reproducible operation. No bench space is occupied if board mounted from island bench shelving, and dangerous solutions can be dispensed safety and cleanly. A further advantage is that each measure delivers its own reagent, and contamination as often happens with badly-washed cylinders is avoided. The measures can be mounted in several ways, e.g. on boards, scaffolding, or clipped on to large stock bottles.

ACKNOWLEDGMENT.—*The author is indebted to the English Electric Co., Ltd., for permission to publish this paper.*

AUTOMATIC DEVICE FOR INTERPOLATORS OF SCALERS

by S. Z. R. Hashmi

Nuclear Physics Section, Hyderabad Science Society, Hyderabad Deccan—6, A.P., India

A three-tube device utilizing a scanning switch is described which automatically counts interpolators' readings of scalers.

SCALERS are often utilized in routine measurements, for example, in radioassay work or photon counting methods for determination of magnitudes of stars. In such cases, the counts indicated on neon interpolators have to be extracted visually and added up. Devices [1, 2, 3], have been developed for extracting fractional counts automatically but these require several items of commercially manufactured gear. The device described here may be found useful by laboratories making their own counting systems. The device starts as soon as the preset timing arrangement of the scaler switches off, scans the indicators, feeds an equivalent number of pulses to the recorder for the glowing neons, resets the scaler, shuts off automatically, and is ready for the next operation, which in this example takes 30 seconds to complete the cycle.

The device consists of a scanning switch, a low frequency R-C oscillator, an amplifier and a conventional power driver for recording counts indicated on neons. Fig. 1 is the schematic diagram of the scanning switch and Fig. 2 gives the circuit of the oscillator, amplifier and power driver. The scanning switch is driven by a fractional h.p., 2 r.p.m. mains-operated synchronous motor. It has three arms A, B and C insulated from each other which sweep electrodes on the three tracks marked A1, B1 and C1. The seven

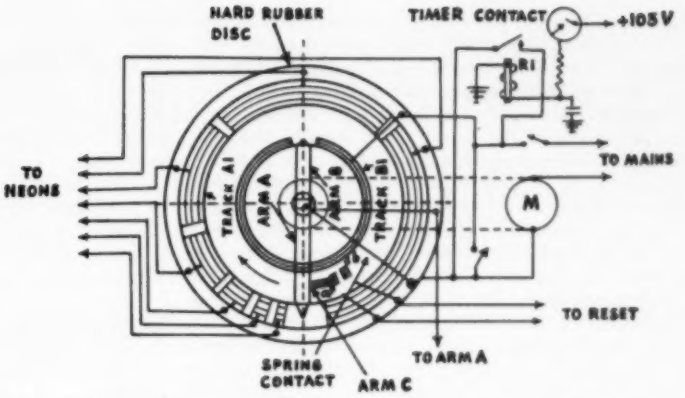

Fig. 1. Schematic diagram of the scanning switch.

electrodes on track A1 are cut out from a brass ring and are embedded in the machined groove of a hard rubber disc so as to be insulated from each other. The lengths of these electrodes are machined to be exactly in geometrical progression starting from any arbitrary length for the smallest electrode. These electrodes are connected, in appropriate order, to neon interpolators of a binary scaler, the magnitude corresponding to the lengths of the electrodes.

Trace B1 consists of a single ring of brass, with a small segment cut out and fitted in its machined groove. Arm C has a metallic strip, fitted in an insulating material, and is fixed to Arm A.

As soon as the preset timing device of the scaler switches off, it closes contacts supplying voltage to relay R1, which closes for a few seconds and then opens, due to R-C network, thereby triggering the motor. The motor continues to revolve, as soon as arm B comes in contact with the ring on track B1, until it comes over the cut-out portion of the contact ring. Arm C short-circuits the electrodes *a* and *b* before the motor stops, thereby closing a relay (not shown here) which resets the scaler. In the meantime, arm A starts sweeping electrodes on its track, and, if any neons connected to the respective electrodes are glowing, then the voltage drop, developed across the 750 K potentiometer, causes the amplifier 6SN7 to close a fast acting relay R2, thereby starting the oscillator. The power driver records the number of pulses received from the oscillator. The oscillator frequency can be pre-adjusted, by means of two 2-megohm potentiometers, so as to give the correct number of counts on all electrodes corresponding to respective neons, so that, after one complete sweep of the arm A, the register will record the sum of all glowing indicator counts.

In practice, these seven electrodes are connected to the last seven indicators of a scaler, so that each count is multiplied by a factor, and the rest of the counts are not taken into account, being negligible. Thus, if the device is connected in this manner to a scaler of 4096, the multiplication factor is 32 and the counts left over are 16—less than 0·5 per cent of the scaling factor. The same is true for scalers having higher scaling factors. A suitable printer can be used instead of a power driver and message register for obtaining a permanent record. More electrodes can be added to cover any accuracy

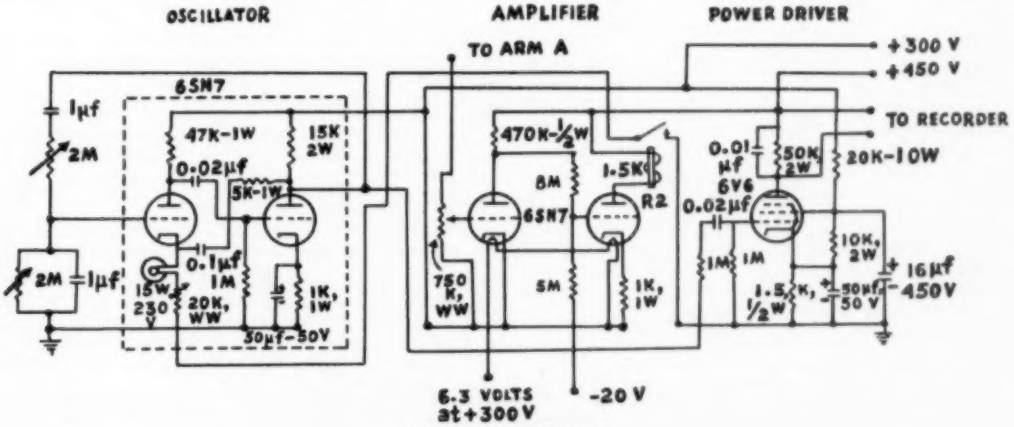

Fig. 2. Circuit of the device.

required. Similarly, electrodes can be designed for use with decimal scalers, when the pulses can be fed to a digital printer. As is obvious, the time period of operation depends on the resolving time of the recorder for the oscillator frequency and speed of the motor, which can be suitably selected to cut down the time of operation. An electronic gate can be used instead of the amplifier-relay arrangement shown here for quicker action at higher frequencies.

The low frequency oscillator (less than one to five counts per second) has been found to be sufficiently accurate for the purpose, provided that good quality components are used and voltages are stabilized. In this apparatus the power for the device has been tapped from the scaler power supply. The machining operations of the device are not particularly difficult and can be carried out in a small workshop. Moving contacts should be firmly mounted so as not to generate noise from dirty contacts as this is likely to introduce extra counts or to cause 'drop outs'. The connections from the neons are tapped after limiting resistors (1 megohm or larger in conventional scalers) so as not to upset scaler readings.

ACKNOWLEDGMENT.—*Thanks are due to Dr. Akbar Ali, Director, Niziah Observatory and Mr. S. B. Hyder of Physics Department, Nizam College, Hyderabad, for their co-operation.*

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[2]Blitgsteen, W. (1953). *Astronomical Photo-electric Photometry*, edited by F. B. Wood, A.A.A.S., p. 83.
[3]For example, Digital Recorder of Berkeley Division, Beckman Instrument Company, Cal., U.S.A.

Forthcoming Congresses

Third Gas Chromatography Symposium

The Third Gas Chromatography Symposium, organized by the Society for Analytical Chemistry and the Gas Chromatography Discussion Group, under the auspices of the Hydrocarbon Research Group of the Institute of Petroleum, will be held at the Assembly Rooms, Edinburgh, from June 8 to 10, 1960.

The programme will be as follows:

June 8

Welcoming address by Prof. E. L. Hirst.
Opening address by Dr. A. T. James.
Report on the status of the East German Working Group by Dr. R. Kaiser.

Apparatus and Technique

Morning Session

Introductory lecture.
Investigation of the hydrogen flame ionization detector, by L. Ongkiehong.
Argon detectors, by J. E. Lovelock.
Comparative data on two ionization detectors, by R. D. Condon, H. N. Claudy and P. R. Scholly.
An examination of sensitive vapour detectors using a diffusion dilution apparatus, by D. H. Desty and C. J. Geach.
Comparison of integral and differential ionization detectors for gas chromatography, by Ing. St. Matousek.

Afternoon Session

Gas analysis by gaseous discharge, by B. Riley.
Vapour flow chromatography, by J. Boeke.
New integrator for and further automatization of gas chromatographical analyses, by I. Halasz.
Cathode-ray presentation of chromatograms, by R. P. W. Scott and C. A. Cumming.

June 9

Theory and Application

Morning Session

Introductory lecture.
Some factors affecting column efficiency and resolution of nylon capillary columns, by R. P. W. Scott and G. S. F. Hazeldean.
Coated capillary columns—An investigation of operating parameters, by D. H. Desty and A. Goldup.
High-speed chromatography, by J. H. Purnell.
Temperature limitations of stationary phases, by W. Gerrard, S. J. Hawkes and E. F. Mooney.
Structural analysis of hydrocarbons by capillary gas chromatography in conjunction with the methylene insertion reaction, by M. C. Simmons, D. B. Richardson and I. Dvoretzky.

Afternoon Session

Improvements in the efficiency of large-diameter gas-liquid chromatographic columns, by F. Huyten, W. van Beersum and G. W. A. Rijnders.
Purification and identification of the components of complex organic materials, by T. Johns.
The determination of specific retention volumes, by E. R. Adlard, M. A. Khan and B. T. Whitham.
The use of some complexes of the transition metals as column liquids in gas chromatography, by G. P. Cartoni, R. S. Lowrie, C. S. G. Phillips and L. M. Venanzi.
Retention times and molecular shape; the use of tri-o-thymotide in column liquids, by A. O. S. Maczek and C. S. G. Phillips.

June 10

General Applications

Morning Session

Introductory lecture.
Gas-liquid partition chromatography for separation of metal halides, by R. A. Keller and H. Freiser.
The gas chromatographic analysis of inorganic halogen compounds on capillary columns, by T. R. Phillips.
The quantitative analysis of mixtures containing nitrogen oxides by gas-solid chromatography, by Melle L. Marvillet and J. Tranchant.
A gas chromatographic apparatus for in-line analysis of corrosive inorganic gases, by G. Iveson and A. G. Hamlin.
Anaesthetics and gas chromatography, by D. W. Hill.

Afternoon Session

Analysis of full boiling range gasolines by chromatographic methods, by R. V. Blundell, S. T. Griffiths and R. R. Wilson.
A new approach to the study and assessment of medicinal white oil stability, by C. G. Scott.
Identification of the structure of involatile organic substances by gas chromatography of pyrolytic products, by J. Janak.
The gas chromatography of ethylenically unsaturated compounds with particular reference to esters, by C. E. Roland Jones.
Fuel gas analysis; an apparatus incorporating a multi-cell thermal conductivity detector, by G. R. Boreham and F. A. Marhoff.
Summing up of Symposium by C. S. G. Phillips.
Closing address by R. C. Chirnside, President of the Society for Analytical Chemistry.

REPORT

GLASS TECHNOLOGY FOR EXPERIMENTAL GLASSBLOWERS

THE ninth one-day Colloquium on Glass Technology for experimental glassblowers was held by the Ministry of Aviation (formerly the Ministry of Supply), in London on Wednesday, December 9. The following programme had been arranged:

Talk and discussion.

'Exploitation of some Physical and Chemical Properties of Glass', by Dr. D. K. Hill, British Glass Industry Research Association.

Talk and discussion.

'Thermometer Manufacture', by D. H. Stout, Esq., of H. Stout and Co. Ltd., Redhill, Surrey.

Four films on glass:

1. 'The Action of the Clinical Thermometer'
2. 'Study of a Glass Fibre Forming Process'
3. 'Glas'—a prize-winning Dutch film
4. 'Glass and You' by Corning Glassworks Ltd.
5. 'Glass' by Pilkington Bros. Ltd.

1. Shown by courtesy of the British Scientific Instruments Research Association.
2. and 5. Shown by courtesy of Pilkington Bros., Ltd.
3. and 4. Shown by courtesy of the Glass Manufacturers' Federation.

In the absence of Dr. Thorley-Lawson, Miss Fox deputised for him and opened the meeting. The chairman was Mr. I. C. P. Smith.

At the beginning of his talk Dr. Hill pointed out that by far the greatest amount of glass melted in terms of tons was that used for containers, bottles, jars and similar articles; and flat glass. The quantity of glass used in some of the less familiar applications he was about to describe was quite small, in some cases only a few tons in a whole year. Many of these applications were fairly new and all of them exploited the peculiar and often unique properties of glass.

All those in the glass industry realized what a peculiar material glass was, but people outside the industry were now beginning to take note of some of these peculiarities and to realize that glass can often make a significant contribution to their own activities.

The peculiarities of glass which are now being exploited include its transparency, strength, electrical properties, hardness, chemical durability, viscosity-temperature characteristics, high temperature stability and compatibility with certain classes of plastics and inorganic composite materials.

The most fundamental of these properties is the smooth change of viscosity with temperature, and this characteristic has enabled glass to be used in a most unusual way in some sections of the metal working industry, i.e. as a lubricant. Non-ferrous metals are often shaped into rods, tubes, or complex sections by extrusion through a steel die. The ingot of metal, either cold or heated to a relatively low temperature, is placed into a container, one end of which is closed by a die. It is then forced through the die by means of a ram. The softer metals can often be extruded cold as long as the die is well lubricated. With ferrous metals, particularly the high alloy steels such as stainless and heat-resisting steels, to obtain any flow at all the ingot temperature must be high, often over 1,300° C., but the container and die must still be steel. In these extremely severe conditions, there is inevitably constant seizing and jamming, resulting in torn dies and scrapped extrusions. Ten years ago the hot extrusion of steel sections was practically impossible, the answer of course lay in using some kind of lubrication. The Frenchman Sejournet tested hundreds of materials as possible lubricants, most materials melted too sharply or reacted with the steel, and eventually he discovered that only glass-like substances could give the desired viscosity/temperature behaviour.

In the early development of this method the glass was used as a solid plate heated to the temperature of the container. The hot ingot entered the container and melted the surface of the glass which flowed between the extrusion and the die. The glass functioned in two ways, by giving a viscous liquid layer between the die and the work piece, and also by insulating the die and reducing overheating.

Having established that glass was the right material the next step was to decide what glass, and in what form it should be used. Clearly for different metals, such as mild steel, stainless, tool steel and pure molybdenum, different glasses are needed. Peyches and Sejournet suggest that the viscosity of the glass at the ingot temperature should be of the order of 100 poises. It is interesting to note that for some extrusions a glass practically identical with plate glass is used. There are, however, a large number of factors other than the ingot temperature which affect the process. One of considerable importance is the thermal 'diffusivity' of the glass assembly. Much better results have been obtained if the amount melting at a given time can be held to the minimum, i.e. the thermal diffusivity is decreased. This can be achieved by using a sintered doughnut of glass particles, or more simply still a wad of glass fibres, instead of a glass plate. Titanium extrusion could be performed using these methods. As a result of the collaboration of a French steel maker (Aceries Electriques d'Ugine) an extrusion expert, Sejournet, and the glass technologist, a major advance in the field of metal fabrication has been achieved. Another use of glass in the steel works mentioned by Dr. Hill was the wrapping of the heated billets in glass cloth before they reach the press, so preventing oxidation. During the pressing

operation the molten glass acts as a lubricant between the billet and the press container. Piercing mandrels are also swathed with glass, and in some steelworks a bath of molten glass is used as a heating element for the reheating furnaces.

Glass in Agriculture

It is well known that for healthy vigorous growth plants require various substances to be present in the soil; among the more common fertilizers are compounds of nitrogen, phosphorus and potassium. Equally essential, but in very much smaller amounts, are 'trace' elements such as iron, manganese, boron, molybdenum, copper and zinc, and in some areas deficiencies of one or more of these elements make it impossible to have normal full plant development.

For example in the relative absence of iron, plants develop chlorosis, the leaves become yellowish instead of green and the plant may die. A detailed analysis of the soil may reveal that the iron content is normal, but the non-availability is due to some chemical reaction in the soil which 'locks up' the iron. This effect can be produced in highly limed soils and again in neutral or alkaline conditions by interaction between the iron and phosphate present. A further cause of chlorosis can be high concentration of manganese in the soil, and although the precise chemical mechanisms for these effects are not known, the use of additional sprays of soluble iron salts does remove the disease. Similarly, plants can be adversely affected by the absence of manganese or other trace elements.

These deficiencies can be overcome by palliative treatments with 'soluble' iron or manganese, but such a treatment has only a limited effectiveness. It can only correct the original soil condition for a short period, because being soluble the trace elements are either washed out or they too become 'locked up' in their turn.

Since the early 1940s work has been going on in various places on the possibility of using glass frit as the source of trace elements. The desirable properties for such a material would be:

Aqueous solubility reasonably low.

Non-toxicity to plants so that large quantities can be added at a single treatment.

Non-reactivity with soil, or with other fertilizers capable of feeding the trace elements to plant roots perhaps by some ion exchange.

There have been a large number of papers on this subject and the trend has been towards a glass in which part of the silica has been replaced by a phosphate. In one case a yield improvement of 45 per cent was found with potato crops. An approximate composition for this type of glass is:

SiO_2	... 39	CaO	... 8
P_2O_5	... 21	MgO	... 8
Fe_2O_3	... 5	K_2O	... 9
MnO_2	... 4	Na_2O	... 9

While these glasses are generally used as frits they have also been used in the form of glass fibre mats laid on the surface of the soil.

Other workers have obtained good results with a glass whose composition is very close to that used for iron-green bottles.

Some Applications of Glass as Fibres

Everyone is aware of the great use of glass fibres for thermal insulation both in the home and in industrial practice. A similar kind of use is in the form of acoustic panels for rooms or halls. Here the glass has a dual function, by providing pockets free from other solid material it introduces acoustic damping, but as the fibres are partly imbedded in the matrix they act as physical reinforcement.

The importance of glass fibres as reinforcement for plastics or other materials is continually increasing. The facts are fairly straightforward. A commercially prepared synthetic resin/glass laminate, using glass in the form of chopped strands has a tensile strength approximately one-third that of mild steel. Hence to obtain equivalent strength the cross sectional area, usually the thickness, must be increased by a factor of 3. But the specific gravity of the laminates is usually less than a quarter of that of the steel, and consequently these materials are weight for weight stronger than steel. The same applies to a comparison with aluminium and its alloys, and also to comparisons based on bending strength. The laminates have a lower moduli of elasticity and higher elongations than the usual constructional metals, but they have the great advantage of not suffering from corrosion, relatively easy execution of complex shapes, easy repairs, and absence of the type of fatigue breakage which affects metals.

The freedom from corrosion of laminates has been exploited in many ways: boats are an obvious example, but oil pipelines in the deserts of the Middle East are also protected with glass fibre cloth or mat, bonded with bitumen or latterly polyester resins.

Dr. Hill concluded his talk by saying that glass fibre has such a multitude of uses that one could go through the alphabet from acid tanks, aircraft parts, belts, clutches, to zoological tanks and still not exhaust all their possible uses.

Many questions were asked at the end of the talk, ranging from the thickness of thin films of glass, the uses of toughened glass as a light shutter, and tellurite glasses, to colloidal glass as a lubricant.

Thermometer Manufacture

Mr. Stout started his talk by explaining that if thermometer bulbs were made of ordinary glass and exposed only to ordinary temperatures then the glass, which acts as a containing vessel for the mercury, gradually contracts. This contraction gradually makes the thermometer give higher and higher readings, although the rate of change diminishes with time. This phenomenon is known as the secular change. By heating the thermometer to about 100° C. and permit-

ting it to cool the situation is reversed and the volume of the bulb is increased—this is known as depression of the zero. Obviously such a useful and important instrument as a thermometer cannot be made from a glass exhibiting these afterworking properties. Therefore the bulbs of thermometers which are to be used up to a temperature of about 400° C. are made of a special glass which is known as Normal glass; this glass does not exhibit these afterworking properties. The stems are made of a lead or soda lime glass. Borosilicate or fused silica glasses are used for higher temperatures. Thermometers can be used at temperatures above the boiling point of mercury (357° C.), if instead of being evacuated, they are filled with an inert gas such as nitrogen; at 30 atmospheres pressure they can be used up to a temperature of 625° C.

Mr. Stout pointed out that because of the considerable variation in the bore of the glass tubing it was not possible to mechanize the production of thermometers, every thermometer had to be made individually by hand methods.

The clinical thermometer has an extremely fine bore, usually between 0·00125 and 0·002 in. in diameter.

Chemical thermometer bores vary between 0·002 and 0·015 in. in diameter and the tubing in this range is usually sorted into 40 sizes.

Spirit filled or alcohol thermometers have bores from 0·01 to 0·025 in. and are usually sorted into 50 sizes.

He then went on to describe the making of thermometers in some detail.

His talk was followed by the film on the Action of the Clinical Thermometer. This was an excellent talk as it did make one aware of the large amount of skilled work that goes into the production of a very important instrument, and one which is usually taken for granted in laboratories.

The second film, a Study of Glass Fibre Forming Processes, was a film made as part of a research programme designed to study the mechanism of fibre formation, using the steam blowing process.

Film number three was a film of a very high artistic standard, in which shots of glassmaking and glass production had been wedded to music of a modern genre.

The fourth and fifth films, both different in their approach, showed glass making and the uses of glass, including some of the newer uses of the material.

J. A. FROST.

The Society for Analytical Chemistry

At an Ordinary Meeting of the Midlands Section of the Society for Analytical Chemistry a paper on 'The Identification and Determination of Phenols', by L. Barker, B.Sc., Ph.D., A.R.I.C., (Leeds University) was presented and discussed.

Determinations have been made of a number of monohydric and dihydric phenols present together in aqueous solution, the source of the material being gas works ammoniacal liquor.

For normal analytical requirements, only the total amounts of these phenols are determined, either by halogenation or colorimetric reactions. More detailed analyses have now been achieved by chromatographic and spectrophotometric procedures. Preliminary investigations were made by solvent extraction and distillation. Distillation fractions were analysed using infra-red spectrophotometry for monohydric phenols, and paper chromatography for identification of dihydric phenols with column liquid partition chromatography for their quantitative determination.

Subsequently it has been found possible to make a relatively rapid and sufficiently detailed analysis of the phenols present in liquors solely by column chromatography and ultra-violet spectrophotometry.

A simple method is suggested for the determination of total amounts of phenols in liquors by ultra-violet spectrophotometry.

Although consideration was restricted to gas works' ammoniacal liquors, it is probable that the methods could be adapted to mixtures of phenols from other sources.

The Royal Society

At the Anniversary Meeting Sir Cyril Hinshelwood, Dr. Lee's professor of chemistry at Oxford University, was re-elected President of the Royal Society. The other Officers re-elected for the ensuing year were: Treasurer, Sir William Penney, K.B.E., member for scientific research, United Kingdom Atomic Energy Authority; Biological Secretary Sir Lindor Brown, C.B.E., Jodrell professor of physiology at University College London; Physical Secretary, Sir William Hodge, Lowndean professor of astronomy and geometry in the University of Cambridge; and Foreign Secretary, Dr. H. G. Thornton, lately head of the department of soil microbiology at Rothamsted Experimental Station.

Other members of Council elected were:

Prof. J. F. Baker, O.B.E., Professor of mechanical sciences in the University of Cambridge.

Dr. J. C. Burkill, University lecturer in mathematics, Cambridge.

Prof. D. G. Catcheside, Professor of microbiology in the University of Birmingham.

Prof. T. N. Harris, Professor of botany in the University of Reading.

Prof. L. Hawkes, Emeritus Professor of geology, Bedford College, in the University of London.

Prof. A. L. Hodgkin, Royal Society Research Professor.

Sir Patrick Linstead, C.B.E., Rector of the Imperial College of Science and Technology.

Dr. R. A. Lyttleton, reader in theoretical astronomy in the University of Cambridge.

Prof. H. S. W. Massey, Quain Professor of physics at University College in the University of London.

Prof. R. A. Morton, Johnston Professor of biochemistry in the University of Liverpool.

Sir Alfred Pugsley, O.B.E., Professor of civil engineering in the University of Bristol.

Prof. R. J. Pumphrey, Derby professor of zoology in the University of Liverpool.

Prof. H. W. B. Skinner, Lyon Jones Professor of physics in the University of Liverpool.

Prof. W. Smith, Professor of bacteriology at University College Hospital Medical School in the University of London.

Dr. H. W. Thompson, C.B.E., University reader in infra-red spectroscopy, Oxford.

Prof. J. Z. Young, Professor of anatomy at University College in the University of London.

DAVID AND GOLIATH

IN THESE days of take-over bids and amalgamations it is perhaps of interest to consider how the interests of the laboratory user are likely to be affected by changes which are occurring in the laboratory furnishing trade at the present time. In recent years we have seen one big get-together, two more of the largest and best-known houses have become united this year, and there are strong rumours of further impending changes of a similar nature in the near future.

In order to examine the situation in any detail it is necessary to ask ourselves what it is that we expect from our laboratory furnisher; when we know the answer to this question it becomes possible to appreciate some of the multitudinous problems that face the trade today. There can be no doubt at all that what we all want is a first-class service; if we reach for the telephone and tell our supplier what we need, then we expect that our requirements will be in our laboratories with the least possible delay; if we require technical information concerning the various apparatus available, then we expect to be able to obtain it at once. Does that seem too much to ask? Of course not—until one begins to think of the almost unending multiplicity of items that are listed in the catalogues. Those catalogues, indeed, have tended to become the 'Bibles' upon which we base all our ideas for the equipping and development of our laboratories.

Who Gives the Best Service?

Now who can best give us this service that we have come to regard almost as a right? Is it the really big furnisher, with large financial resources, a fleet of delivery vans, a comprehensive catalogue listing about 40,000 different items, enormous stocks, and a well-staffed development and technical section? Or is it, rather, the smaller man who knows us personally and who is ever willing to put himself to no end of trouble in order to ensure that we get just what we want when we want it? There are few who would care to deny that this personal touch is unavoidably lost, to a large extent, when a firm becomes a giant; a breakdown into specialized departments is essential, with the result that customers, even with the best will in the world, have a tendency to become names rather than distinct and individual human beings.

Now that specialization is so very much with us, it has become quite impossible for the smaller traders to keep stocks of all the lines for which they may be asked from one week's end to the next, and such houses are, of necessity, able only to carry on their shelves those items for which they are most frequently asked; when non-stock articles are required supplies must be obtained either from one of the bigger trade-houses or from a specialized manufacturer. The giants of the trade, however, can afford to have on their racks an enormous number of different pieces of apparatus which enable them to offer speedy deliveries to all types of laboratory.

The Two Alternatives

We are faced with two alternatives: do we place our business with one of the large laboratory furnishers in the hope that we may be lucky enough to get an off-the-shelf delivery, or do we send our orders to the smaller man who will regard them as favours from a friend and do his utmost to reciprocate to the best of his ability? The answer is far from easy and each buyer has his own personal opinion which he will defend tooth-and-nail.

It may well be thought that the best solution is to divide the orders between a number of suppliers, and this system certainly has its advantages when specialized 'capital' equipment (e.g. ovens, balances, humidity cabinets, etc.) as well as run-of-the-mill apparatus (glassware, ironmongery, etc.) is required. On the other hand, the smaller man is very willing, normally, to arrange to carry stocks to meet any demand of which he is forewarned; if he knows that a customer is going to take, say over a period of a year, a certain quantity of a somewhat unusual size or type of flask, then he will readily arrange to carry what is required in order to be able to give both a personal and an off-the-shelf service.

An Inbred Leaning

These days it is not unusual to find that the bigger firms support large technical and development departments; their job is not only to carry out research into the production of new apparatus and instrumentation, but also to offer to their customers a sound and first-class advisory service. Since such departments are not infrequently staffed with some of the most widely recognized technologists in the country, it is difficult to see how, in this respect at least, the small man can compete. Is it right, under such circumstances, to give the 'bread-and-butter' to one supplier while passing all the problems to a second company which expends large sums in order to maintain a fully qualified technical staff?

There is, of course, the natural tendency in this country to support the individual in the face of opposition from the giant combines, but, surely, in order to determine the way in which we can obtain the best service, we must, if necessary, be prepared to break through this inbred leaning. Yet again, can one afford to lightly toss away the personal relationship which can be so easily and advantageously built up with the little man? If the big houses can, in some way, devise a means by which each of their customers can be treated always as known personalities, then there would seem to be little doubt but that, with their greater resources, they can offer a better all-round service. Until such time, however, as one or more can offer persistent concrete evidence of ability to give this invaluable personal service, then the laboratory user must continue to be faced with the problem of selecting the type of supplier which can best give the sort of service that he requires.

Time Will Tell

Since the laws of nature indicate the survival only of the fittest, this problem will, in course of time, resolve itself; at present, however, it is definitely true to say that we are still a long way from the end of the road. There are many who will say that the days of the small laboratory furnisher are numbered in this era of vast technical development, but, in the ultimate, it is the buyers who decide who will go to the wall, and there are still a number of small firms who appear not only to be able to satisfy the demands of their customers extremely well, but also to be flourishing and constantly increasing their turnover. Time alone will tell, but meanwhile the buyer must continue to face the problem of whether to send his orders to Lilliput or Brobdingnag.

News from the British Association of Chemists

PROPOSED NEW INSTITUTE OF CHEMICAL TECHNOLOGY

Readers of this page will recall that a preliminary report of the meeting of representatives of Technical Colleges training students for H.N.C. in Chemistry, held at Crewe on October 17, 1959, appeared in the December issue of *Laboratory Practice*. It is now possible to give a précis of the remarks made by those present. The President of the B.A.C., Mr. John Wilson, who took the Chair, opened the proceedings by saying the proposed Institute would fill the gap which resulted from the refusal of the Royal Institute of Chemistry to create a third grade of membership, to which holders of the Higher National Certificate in Chemistry would be eligible. The problem had first been put to him by the late Prof. Wardlaw, F.R.S., during the meeting of the R.I.C. in Edinburgh, nearly two years before. He had, however, come to the conclusion that the B.A.C., as such, was unable to take any effective action and that the only solution was to form a new institute. Such a venture could not possibly succeed unless it had the backing of the bulk of the Technical Colleges throughout the country and the reason for the present meeting was to find out whether that was so or not.

A delegate then asked if another name had been suggested for the proposed Institute as he knew that a number of people were doubtful about the title of Institute of Chemical Technology. Mr. Wilson replied that various names had been suggested, but nothing had been decided. If there was a body of opinion in favour of a new Institute he planned to form a Steering Committee which would be representative of every district in the country. This committee would direct policy and settle details including the name. At present nothing was decided.

A question was then asked as to what relationship was envisaged between the new Institute and the R.I.C. Mr. Wilson replied that he understood the R.I.C. would look with favour on the formation of a new Institute provided it set out to do a real job of work and he understood they would be prepared to help and advise on the formation of the new body. He hoped therefore that the Institute would nominate two or three representatives on the Steering Committee which would make all the decisions. A delegate then said that he felt that if the Institute was going to be an Institute of Technology it would be essential to teach H.N.C. people technology. He asked how many colleges were equipped to teach chemical technology; there was neither the staff nor the equipment and both were very difficult to get. Mr. Wilson pointed out that the bulk of the firms in this country employed less than 200 operatives. Firms of that size could not make use of a first-class honours man because he was too limited in outlook. Such firms wanted men with wider knowledge and interests. The new Institute, if formed, would set out to encourage the training of such people by helping to plan courses at H.N.C. level more suited to the requirements of the local industrialists. The precise nature of the courses would vary from college to college, but if the courses were of real value the industrialist could afford to pay the men who obtained the qualification and there would be an inducement for students to take up the course.

A delegate said that he was concerned as to whether it was intended that membership of the new Institute should constitute a full professional qualification. He felt that the requirement of ancillaries seemed to be the thing which the new Institute was attempting to dodge. He thought that if a man was going to achieve full professional status he needed to be not only a chemist, but also to have a wider approach. Another delegate said that from his own experience an H.N.C. man was not given credit for the work he had done. He thought that in industry a graduate would always be regarded as superior to the H.N.C. man, but perhaps the proposed new Institute would enable the H.N.C. holder to obtain some sort of recognition and qualification thereby reaping some reward for his work. Another delegate said that in his own College he thought that the majority of those who were not suitable Grad.R.I.C. material had no opportunity of becoming members of a professional organization they would continue studies with a view to obtaining the endorsements which had been suggested as a basis for the new Institute. Another speaker said that at his College on the whole they were not opposed to the scheme as it could provide scope for new courses at post H.N.C. level not suitable for G.M.R.I.C., and they had many H.N.C. people who did not go forward to G.M.R.I.C. They were worried by the apparent equation of the proposed qualification with A.R.I.C. and suggested that the first grade of membership should be a licentiateship. They also did not like the word 'technology' in the title because of its confused interpretation. Mr. Wilson said that he had merely been trying to say that after H.N.C. in chemistry there should be two alternative courses, the R.I.C. course and a technological course. It has not been his intention to imply that the two were necessarily of the same standard.

Another speaker wished to query the basic assumption that the problem was so great. There had been a great deal of talk about the 80 per cent who obtained the H.N.C. in chemistry but did not proceed to A.R.I.C. and the fact that a considerable proportion were incapable of achieving that standard seemed to have been overlooked, and a previous speaker had spoken about H.N.C. people who were being exploited by industry and he said he did not dispute this, but on the other hand there was one firm in his area which paid so well on H.N.C. standard that employees could see no reason to go further. If it was therefore remembered that there were such cases among the 80 per cent the danger would be realized of basing any generalized argument on the percentage. He thought, therefore, that the proposal was premature and considered that a great deal of research was needed to establish why there was the 80 per cent and what it really meant. Another thing he would like investigated was the question of endorsements on the H.N.C. and why they were not working satisfactorily. There again, he thought an answer to the problem was required before setting up fresh machinery was considered.

Mr. Priestly of Leicester said he was only present at the meeting as an observer for the R.I.C. and had no authority to speak for it. He undertook, however, to pass on the views that were held so strongly by the technical college representatives present in respect of a third grade of membership.

Another speaker said the question had been asked why didn't students take endorsement subjects in H.N.C. in chemistry. Far from being premature this Institute was overdue and he was firmly of the opinion that something on those lines should be put in hand. The diversity of ideas put forward at this meeting was indicative of the profession of chemistry. They were too individualistic. Much closer unity seemed to exist in other professions, notably the medical and dentistry professions. The minimum qualifications for practice were far from being the highest obtainable, whereas in chemistry nothing short of the top seemed acceptable. He pleaded for some unanimity of opinion, so that something definite might be done for the benefit of say 50 per cent of the 80 per cent who did not at present proceed to A.R.I.C. or a Degree. Given encouragement and prospects of recognition many of these students were capable of going further. The proposed new Institute could do that.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

Laboratory Note-Book

THE Machine Tool Traders Association and the Department of Scientific and Industrial Research are continuing their discussions of the action to be taken as a result of the D.S.I.R. survey of the research and development requirements of the British machine tool industry. A further meeting was held on December 8, 1959 at which representatives of the Ministry of Education were also present. The meeting was concerned with two major subjects, education and research.

On education, the representatives of the industry concurred in the view of the Ministry of Education that the existing education and training facilities for students proceeding beyond Higher National Certificate level could be more fully used, but that more specialized courses were also necessary. There was a need both for more students and more teachers. The representatives of the Ministry of Education invited the industry to assist in reviewing the curricula of existing courses and in devising any necessary new courses.

On research, the meeting noted that D.S.I.R. grants for research in the field of machine tool technology had already been made to two universities and that others were under consideration. It was also noted that exchanges of visits between research engineers from the National Engineering Laboratory and engineers from machine tool firms had taken place. More were being planned.

While appreciating the advantages of making more use of existing facilities for research, the representatives of the industry undertook to give further consideration to the type of research organization most suitable to the needs of the industry. It was agreed that there was a need for much closer co-operation between engineers and designers in industry on the one hand, and the research work of universities, colleges and research institutions on the other.

Discussions will continue in further meetings on specific aspects of the problems involved (education, research, design). A further announcement will be made when a co-ordinated plan has been agreed.

Solar Heat for Swedish Laboratory

The new Swedish astronomic observatory headquarters to be built at Anacapri on the Isle of Capri, Italy, will probably be first in Europe to use solar heat as a means of heating, according to a statement by Prof. Yngve Ohman. Prof. Ohman recently returned to Sweden after last year's solar research season on Capri.

The new building, replacing an older villa at Anacapri which the Swedish observers have occupied since 1952, will contain laboratories, observatories and living quarters. A 'sun catcher' placed at the outer south-west wall of the building will absorb the solar energy. By means of circulating water it will be used for heating the house. The Italian climate is well suited for this kind of heating, but solar heating should, according to Prof. Ohman, also be applicable in North Sweden during the summer season.

Prof. Ohman is also investigating the possibilities of transforming solar heat into electric energy to be used at the Swedish mountain observatory outside Anacapri. At present the observatory gets electricity from a windmill generator since there is no high-power current available.

Mechanization of Thought Processes

The Full Proceedings of the Symposium on 'The Mechanization of Thought Processes' which was held at the National Physical Laboratory in November, 1958, have now been published in two volumes (H.M.S.O., price 50s.).

They contain a group of about 40 related papers. In the fields of pattern recognition, learning mechanisms, mechanical translation and automatic programming, research workers of international repute have described their recent work. The discussions, in which about 200 scientists from 15 countries took part, occupy over one third of the contents (i.e. both volumes).

Some conclusions emerge from a comparison of the Proceedings with those of the Third London Symposium on Information Theory in 1955. There has been some real progress in all the fields, although satisfactory solutions to most of the problems are still some way off. One point, however, stands out. A link has been firmly established between the physicist and engineer, on the one hand, searching for new ideas on which to base new computer designs, and the psychologist and physiologist, on the other, seeking to understand the functioning of the human brain. The rate of progress of both groups is increasing with the cross-fertilization of their ideas at conferences of this kind.

Mechanical Engineering Research

Further developments in the work of the National Engineering Laboratory at East Kilbride are announced in the last Annual Report of the Mechanical Engineering Research Board (Mechanical Engineering Research 1958, H.M.S.O., price 4s. 6d.).

The Report of the Director of the Laboratory (Dr. D. G. Sopwith, C.B.E.), which is included in the same volume, describes the work in progress during the year, including the following:

Slipping of locomotive wheels.—Laboratory tests suggest that the adhesion between railway wheels and rails may be increased considerably by applying a solution of sodium metasilicate to the surfaces. Full-scale tests are now desirable to see whether similar improvements can be obtained in practice.

Air bearings for machine-tool slideways.—Air-lubricated bearings have been used experimentally in place of the normal slideways of a horizontal milling machine. A much smaller motor is required to drive the machine table and 'stick-slip' friction is eliminated.

Pressure losses in oil fittings.—Nine manufacturers of control valves for hydraulic presses, needle valves, positive-displacement flowmeters, and other fittings for oil hydraulic circuits have used a special rig at N.E.L. to measure the pressure losses in their products. The data will enable users of these fittings to design more economical circuits than at present.

Extrusion of aluminium.—When extruding certain aluminium alloys, the product will have poor mechanical properties and its surface may be cracked ('hot shortness') if the temperature becomes too high. With the high-strength aluminium alloy D.T.D. 363 'hot shortness' occurs when the temperature reaches about 480°C. This temperature may be reached under various combinations of initial billet temperature, extrusion ratio and ram speeds. In industry this alloy is usually extruded at an initial billet temperature of 400°C.; with this initial temperature, ram speeds must be kept low to prevent the onset of 'hot shortness'.

Steam Tables.—The Laboratory's DEUCE computer is being used in the preparation of new International Tables for steam, covering temperatures up to 800°C. and pressures up to 1000 atmospheres. The work is being carried out as part of the programme of the International Co-ordinating Committee set up by the Fifth International Conference on Steam.

Creep to fracture under complex stresses.—A limited amount of creep deformation may not matter in pressure vessels, steam pipes and similar structures as long as fracture does not take place. To design such structures economically it is necessary to know how the creep strain in the region approaching fracture is related to the applied stress at a given temperature. It has been found experimentally that the criterion of fracture depends on the way cracks form and grow in the material. In copper at 250°C. and a molybdenum steel at 550°C., for example, cracks form in the early stages of creep and grow relatively slowly during tertiary creep to cause eventual fracture—with these materials the criterion for fracture is the maximum principal stress. On the other hand, in aluminium alloy B.S. 2142 at 200°C., cracking does not occur until immediately before the final fracture—here the stress criterion for fracture is the octahedral stress.

LABORATORY EQUIPMENT & APPLIANCES

The Portalab

The Portalab is a compact and comprehensive portable chemical laboratory, designed by Dr. H. Medlinger, containing ample apparatus and over 100 chemicals for work covering various examinations (Ordinary and Advanced Level Certificate of Education, National Certificate, etc.).

The equipment, amounting to more than 40 items, excluding chemicals, includes full apparatus for gas preparation and collection, a Liebig condenser for distillation, examination grade graduated flask, burette and pipette for titration, wide-range thermometers, combustion tube and boat, blowpipe, stainless spatulas, etc. All parts are standard and easily replaceable.

Where laboratory accommodation is inadequate or non-existent, practical work may be carried out in any room which has a level bench or table.

Even where a laboratory exists the Portalab eliminates time-wasting preparatory work during the lesson; practical work can begin at once and the full lesson period can be utilized. Even a 35 minute period can now be used for practical work. Clearing away time is reduced to a minimum, as the Portalab is allocated to the same pupils throughout the term. Checking is easy as every part fits into its place.

Small-scale work saves time and reduces the cost of materials considerably. It is also helpful in lessening the risk of major accidents.

The layout of the Portalab encourages neatness and accuracy. The stimulating effect of working with an attractive miniature laboratory is considerable and the frequent opportunities for personal practical experience of chemicals must have a positive effect on examination performance.

(Manufacturers: Aimer Products Ltd., 56-58 Rochester Place, Camden Road, London, N.W.1.)

The Portalab—a compact and comprehensive portable chemical laboratory.

Gamma Ray Irradiation Cell

This equipment is built by the Atomic Energy of Canada Ltd., and is now being marketed in this country. It is suitable for laboratory experiments and small scale radiation processing.

Some investigations for which the equipment is suitable are: irradiation of plastics, radiation chemistry, production of mutations in seeds for agricultural research, the destructive effect of radiation on materials and the preservation of food. It can also be used for the sterilization of pharmaceuticals, surgical equipment and other materials.

Gammacell installation, by courtesy of *Centre d'Etudes pour les Applications de l'Energie Nucleaire, Mol (Limbourg), Belgium.*

The unit is self-contained and can be installed in existing laboratories. Operation is simple, remote handling is not necessary, and the external radiation field is very low. No radiation hazard can occur due to mishandling.

The radiation source consists of a ring of Cobalt 60—rods, mounted around a stainless steel cylinder which is embedded in a shielding block. The cylindrical sample chamber is loaded and unloaded above the source, into which it is moved by a motor. The sample volume is 6 in. diameter $\times$ 8½ in. high. The irradiation dose rate with a 1,100 curie source is approximately 10^5 roentgens per hour. The maximum source strength will depend on working conditions near the cell and will be between 13,000 and 30,000 curies, giving a maximum dose rate of about 2×10^6 roentgens per hour.

Samples may be irradiated for a preset time, adjustable between 18 minutes and 120 hours and the remaining irradiation time is indicated, if for any reason irradiation is stopped before the desired time is completed.

Four ducts connected to the sample chamber allow the entry of pipes carrying liquids or gases and wiring, thus enabling irradiation in a controlled atmosphere to be achieved.

The overall dimensions of the whole approximately cylindrical unit are 40 in. $\times$ 60 in. $\times$ 77 in. high and the weight is 7,600 lb.

(Available from: Watson & Sons (Electro-Medical) Ltd., Industrial Division, East Lane, North Wembley, Mddx.)

A New Stopcock

This stopcock has been designed to overcome the disadvantages of the all-glass stopcock (breakage) and all-polythene (leakage). In effect it gives the best of both worlds.

The glass-to-glass bearing gives a smooth and leak-free action, consistent with a well-made all-glass stopcock, and

the polythene outer and side arms give it flexibility and resistance from breakage.

The patent allows for this stopcock to be made in all shapes and forms, and also that the 'key' be made in plastic with a glass outer as an alternative.

At the moment the standard item, that is the all-glass key model 4 mm. bore, is going into production and should be available in a month or two, various improvements and other sizes being added from time to time.

These will be used mainly for aspirators and desiccators. (Patent pending No. 6707/58.)

(Manufacturers: R. W. Jennings & Co., 12/14 Stoney Street, Nottingham.)

Ohaus Double and Triple Beam Sliding Weight Balances

Ohaus double- and triple-beam sliding weight balances are now available in this country. These balances, made to high standards by one of the largest balance manufacturers in the U.S.A., incorporate many notable technical features. Favourable tariff rates, however, enable them to be marketed at unusually low prices.

Included in the range is the Cent-O-Gram, a 311 g. capacity model which offers the convenience of the sliding weight principle with the remarkable sensitivity of ·01 g. The Cent-O-Gram is a triple-beam, single-pan model incorporating a special specific gravity weighing platform, a built-in round spirit level and graduated end-reading scale and pointer to eliminate parallax error. The stainless steel pan is automatically positioned in the pan holder. This balance costs only £16. 16s. 0d.

Three double-beam models are available, all of 2 kg. capacity and 0·1 g. sensitivity. Model 0-1550-S, at £10. 12s. 0d., has 6 in. round plates in stainless steel (or in opal glass at £10. 18s. 0d.). Model 0-1510, at £11. 18s. 0d., has matched removable stainless steel pans. Model 0-1560-S, at £12. 18s. 0d., is similar to Model 0-1550-S but with a 160 g. capacity undivided tare beam.

The triple-beam models are single pan types of 2610 g. capacity (with attachment weights) and 0·1 g. sensitivity. Model 0-750-S with 6 in. steel plate costs £9. 18s. 0d. Model 0-760 is similar, but with 180 g. capacity undivided tare beam, and costs £12. 4s. 0d. Model 0-730, at £17. 10s. 0d., is fitted with a removable 9 in. diameter × 6 in. high aluminium animal box.

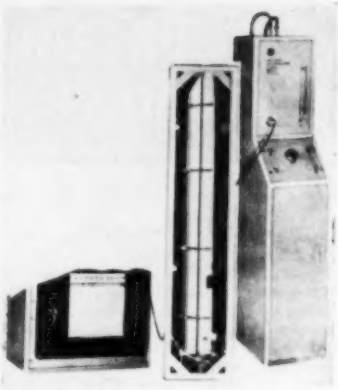
Ohaus technical features include semi-rigid self-aligning agate bearings and hollow-ground steel knife-edges; dust-proof bearing covers; patented scale-plates with threaded hubs; and relief-etched stainless steel beams to ensure that scale markings remain clear and unmistakable throughout the life of the balance. Special attention is given to corrosion-prevention by careful choice of materials and finishes.

All Ohaus models are available with metric, avoirdupois or grain calibrations. (Available from: Shandon Scientific Company Ltd., 6 Cromwell Place, London, S.W.7.)

Ohaus double-beam balance with 6 in. diameter round plates in stainless steel or opal glass.

Isojackets for Argon Chromatograph Unit

A heating device has been made for W. G. Pye & Co., Ltd., of Cambridge. The problem was to design and construct heating equipment for the 4 ft. long × 2½ in. diameter heating column of the Pye Argon chromatograph unit, with provision for any selected temperature up to 250° C., with ½° accuracy, even distribution of temperature over the whole length and a temperature rise at the rate of 10° C. per minute.



Isojackets for Pye Argon chromatograph unit.

The answer to this heating problem was an Isojacket incorporating two interleaved heating circuits—one enabling the temperature to be maintained at the selected level, the other catering for the quick rise in temperature specified. A series of experiments resulted in the exact additional heating for the ends of the jacket, plus certain draught screens and cooling slots.

(Manufacturers: Isopad Ltd., Barnet By-Pass, Boreham Wood, Herts.)

New Portable Mixer

With the Pioneer mixer, users have the advantage of a completely portable unit capable of mixing very small batches from 25 gallons to batches as large as 1,000 gallons, usually only possible with permanent installations.

Although the mixer can be supplied on a mobile stand, it is also suitable for clamp mounting, which gives universal movement so the mixer head can be correctly positioned in the mix.

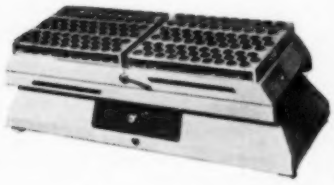
This latest addition to the portable mixer range has been designed for use at either high, medium or low speeds. Totally enclosed and flame-proof, there are various motors available both for single and three phase, from 1/2 h.p. to 1 h.p. ranging from 400 to 3,000 r.p.m. The built-in 'reduction' gearbox for the slow speed unit is integral with the motor casing and is so small that it makes little difference to the weight or overall dimensions as compared with the directly driven unit. This novel design also ensures that the motor and mixer shaft are co-axial. The gearbox, which runs silently, is fitted with non-metallic gears, obviating the need for an oil bath, and requires only very occasional maintenance. Dependent on speed, this mixer can be supplied with a patented Dispersator or stainless steel marine-type propellers to match the particular speed and horsepower of the

unit recommended. Shafts in 18/8 stainless steel come in various lengths according to requirements and can be rapidly changed from one length to another.
(Manufacturers: Premier Colloid Mills Ltd., Hersham Trading Estate, Walton-on-Thames, Surrey.)

The 'Bara' Laboratory Shaker

Designed to minimize noise and vibration, this shaker is of robust construction, and all parts are carefully fitted for silent operation and for long service with the minimum of maintenance. The tray, which, in the illustration, is shown with six Kahn racks in position, is made of sheet steel and rubber lined. It is supported on four rollers and is oscillated by a connecting rod from a crankshaft, which is driven from a geared motor by a V section canvas reinforced rubber belt. Racks are held rigidly in place by a quick release locking lever. An attachment to hold bottles is also available. The base of the shaker is made of sheet metal and is fitted with four rubber suction feet; a clip is provided at each end for permanent fixing if required. On the front of the base there is a mains switch and pilot light, and a rheostat control with an off position.

The length of stroke is 1½ in., and a rate of 275-280 oscillations per minute is easily attained. The overall size of the equipment, which is finished in grey stoved enamel, is 30 in. x 11 in. x 8 in. high, and the weight is approximately 44 lb. The equipment is supplied with 4 ft. 6 in. of 3-cored rubber cable for connection to mains, and is available for operation on 100/120 V. or 200/250 v., a.c. Racks and the bottle attachment must be ordered separately.
(Manufacturers: Baird & Tatlock (London) Ltd., Chadwell Heath, Essex.)



'Bara' laboratory shaker.

Manufacturers are asked to co-operate by sending details and photographs of any new laboratory equipment and appliances they may produce.

Readers, when writing to manufacturers, are requested to mention LABORATORY PRACTICE.

Allen M.109 magnifier.

Illuminated Magnifier for Flat Objects

An unusual illuminated magnifier specially designed for use in examining and also working on maps, charts, engravings, textiles and printed matter of all kinds has just been put on the market by a company who specialize in lighting and optical equipment for visual inspection.

The magnifier, the Allen M.109, consists of a spun aluminium body 8 in. in diameter x 6 in. high which has fitted in the top a 5 in. diameter optically correct lens which gives an area magnification of 4x. The design of the lens gives true binocular viewing *without distortion* over the whole area covered and without eyestrain when used continuously.

Lighting comes from an 18 watt 25 volt lamp fed from the main through a Dohm safety transformer plug which plugs directly into a standard 3 pin mains outlet. There is thus no possibility of a shock since the whole of the unit and the 10 ft. of connecting cable has only 25 volts in the electrical circuit.
(Manufacturers: P. W. Allen & Company, 253 Liverpool Road, London, N.1.)

New Gas-Liquid Chromatographic Detector

A new chromatographic detector, originally designed by Dr. D. W. Turner of the Imperial College, is now available.

The detector, which is both robust and flexible in application, depends for its action upon changes in dielectric constant of the emergent stream: this may be either gas or liquid. Changes in the electrical capacitance of a suitably designed cell are converted into corresponding voltage fluctuations by means of an adjoining unit.

The detector cell may work at or above the column temperature and owing to its unique design, and unlike the catharometer, it does not need to be thermostatically controlled. The convertor assembly is thermally insulated from the cell and its temperature remains low even when the cell reaches its normal maximum working temperature of approximately 250° C.

In addition to the sensitivity of the unit (which is comparable with that of the catharometer), this method of detection is absolutely independent of the rate of the gas flow. It gives a uniquely positive signal with gases and has a very long linear range, it is thus particularly suitable for preparative scale chromatography. The instrument also responds satisfactorily with liquids of low dielectric constant which are commonly used as solvents, e.g. benzene, cyclohexane, toluene tetralin, etc.

This versatile instrument is capable of very wide application in industrial gas and liquid stream analysis, particularly in the petroleum, paint and essential oil industries, and to a variety of laboratory chromatographic separations.
(Manufacturers: H. Tinsley & Co., Ltd., Werndee Hall, South Norwood, London, S.E.25.)

Electric Melting Point Apparatus

One of the commonest operations in organic chemical synthesis, the determination of melting point, is widely taken for granted, the technique and apparatus used often varying greatly. While there is no reason to believe that these variations lead to serious discrepancies, the development of the electrothermal melting point apparatus has made it possible regularly to obtain reproducible results of known and constant accuracy.
(Manufacturers: Electrothermal Engineering Limited, 270 Neville Road, London, E.7.)

Electric melting point apparatus.

NEWS

General

The Polarographic Society

Mr. W. J. Parker has resigned his position as Secretary of the Polarographic Society. Mr. J. H. Glover has been co-opted as Secretary and all communications to the Society including subscriptions should be sent direct to him at 75, Craven Gardens, Wimbledon, S.W.19.

New Company Formed

A new company, Willis Instruments Ltd. of Field Road, Busby, Lanarkshire, has been formed in the West of Scotland to manufacture gas detecting instruments and alarms to certified and approved designs. They will also provide 24 hour servicing and maintenance facilities for all types of electric and electronic scientific instruments.

Mr. Alex N. Willis, managing director of the new company, was until recently Chief Development Engineer (Instruments) with Mine Safety Appliances Co. Ltd., Glasgow. He was responsible for the application of U.S. designs to the British market and for the development of new instruments. He is one of the few British authorities on the design and application of hot wire type combustible gas detecting instruments.

Publications

Quality in Laboratory Animals

The report of a symposium on quality in laboratory animals held at the Royal Veterinary College, London, on April 16, 1959 has now been published by the Laboratory Animals Centre and is Number 8 in the series of Collected Papers (price 10s.).

The contents include the Introductory Paper, Quality in Laboratory Animals, by J. Stuart Paterson, PH.D., M.R.V.C.S., D.V.S.M.; the Investigation of Specific Responses in Laboratory Animals, by Annie M. Brown, B.SC., PH.D.; Establishing and Maintaining a Colony of Specific Pathogen Free Mice, Rats and Guinea Pigs, by D. G. Davey, O.B.E., M.SC., PH.D.; the Achievements of Selective Breeding, by D. S. Falconer, B.SC., PH.D.; Nutritional Factors affecting Quality in Laboratory Animals, by A. N. Worden, M.A., F.R.I.C.; Latent Infections in Laboratory Animals: Their Importance and Control, by E. Sacquet; and Pathological Changes in Old Rats in Relation to Chronic Toxicity Tests, by P. N. Magee, M.B.

Evaluation of Results

A useful review, *Evaluation and Presentation of Spectro-Analytical Results*, has been published by Hilger & Watts Ltd. (price 5s.) and is concerned essentially with the types of error arising in chemical and instrumental analysis, their mathematical treatment and the application of their treatment to spectro-analytical problems.

Written by A. B. Calder, B.SC., PH.D., F.R.I.C., F.I.S., the book stresses the importance of indicating how the errors are distributed in multistage analytical techniques and the great saving in operational time which can often be effected, without loss of accuracy, by correct interpretation of the analytical data.

In his preface, the author states that he hopes a perusal of the book will make the reader bear patiently with the idea of presenting results in the form $x \pm y$.

B.C.I.R.A. Annual Report

The thirty-eighth annual report of the British Cast Iron Research Association for the year ending June 30, 1959, has recently been published and contains full details of the work of the research, development and information departments.

Manufacturers' News

A Laboratory Design Service

Scientific Installations Ltd. announce the formation of the S.I. Group. The aim of this new Group is to provide a comprehensive laboratory design service for scientists, doctors, teachers and technologists.

The service bridges the gap between the man at the laboratory bench, with his own particular problems, and the variety of separate organizations who can interpret and provide the necessary facilities. In the past, each time a new laboratory project has been started, it has meant starting from the beginning and going over the same ground already covered by others. This can lead to delays and expensive errors, as well as the running of the risk of having to make economies towards the end of the project which, inevitably, affects the end-product.

With the quickening pace of scientific and industrial progress, new demands are being made on research. First class design and first class equipment are essential for the modern industrial and scientific laboratory. The S.I. Group, under Peter Brassington, the managing director, set up a committee to examine a variety of laboratory problems, taking actual briefs through each design process from the task plan to the finished product. The result is a complete knowledge of modern trends for the planning, building and equipping of complete projects. The full service is given under the one roof or specific services can be called for; for this reason it is felt that it is particularly useful to architects, who may need expert advice on, for example, laboratory fittings.

A booklet, 'Have you a planning problem?' which describes the service, is available on application to Scientific Installations Ltd., 1 Salisbury Square, London, E.C.4.

Quickfit Range Extended

The following items have been added to the range of Quickfit glassware, available from January 1, 1960;

Nitrogen Determination Apparatus.—This apparatus is a modification of the conventional Kjeldahl method. Ammonia is entrained in a stream of air instead of steam, with the advantages that very small quantities can be estimated accurately; heating and cooling to distil are avoided; the same test tube is used for digestion and aeration; the whole apparatus is neat and compact; several units can be connected in series in a very small space; aspiration can be provided by an ordinary filter pump.

Stirrer Gland.—The stuffing box type of stirrer gland is now available in Fluon.

Freeze Drying and Sublimation.—Large size lyophiliser and trap are now included in the Quickfit range. In most cases standard parts and assemblies can be used for freeze drying and sublimation.

Soxhlet Extraction with Cold Solvent.—This apparatus, of 60 ml. nominal syphoning capacity is provided for use when it is essential to extract a solid with cold solvent, e.g. when the substance to be extracted is heat sensitive.

Catalogues, Brochures & Leaflets

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd. of Poole, Dorset, are listed in the December, 1959, issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Boron trifluoride diethyletherate; 2:3-dimercapto-propan-1-ol (BAL; British Anti-Lewisite); *In* nonylamine; and SPADNS.

Organic Chemicals.—L. Light & Co-Ltd., of Colnbrook, Bucks., have just issued a new list of Organic Chemicals for 1960. They have constantly improved the quality of their chemicals by purity control in a new analytical laboratory utilizing all the latest physical methods including U.V. and I.R. quantitative spectrography.

Laboratory Equipment.—A. D. Wood, 4-5 Skinner St., London, E.C.1, have just published a new 1960 edition of stopcocks. They have increased their range considerably by including Quickfit & Quartz apparatus and Edwards High Vacuum equipment.

M. & B. Research Chemicals.—A new descriptive list of Research Chemicals have been published by May & Baker Ltd., of Dagenham, Essex. The range contains more than 250 products that are of special interest to the organic chemist.

'Scientific' News.—The second issue of 'Scientific' News published by Scientific Supplies Co., Ltd., of Scientific House, Vine Hill, London, E.C.1. detail recent additions to the Exelo range, the E-MIL range and Chance's microscope cover glasses.

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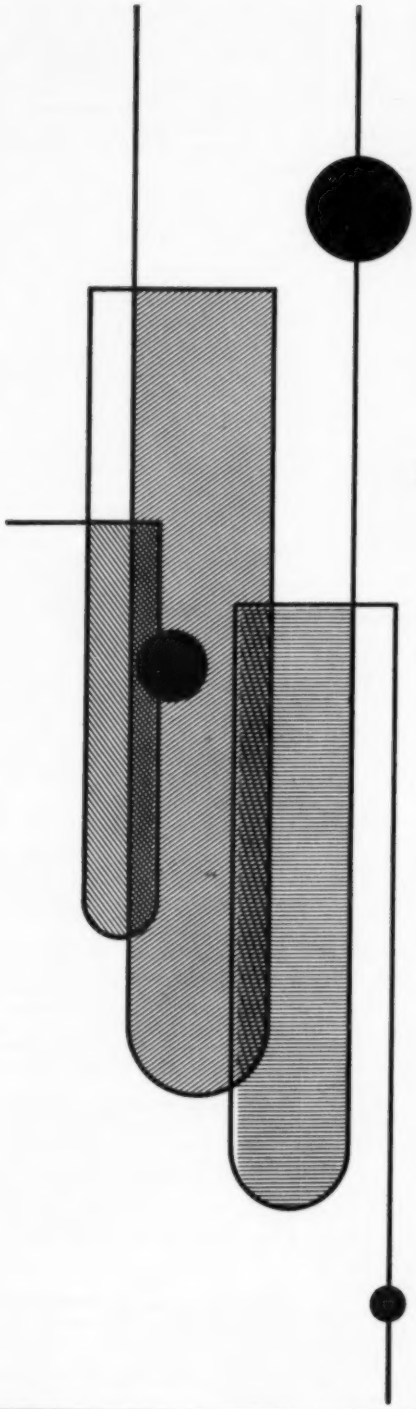

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MEETINGS FOR THE MONTH

Mid-February to Mid-March

We give below a selection of meetings of interest to laboratory workers. Details are as full as possible at the time of going to press, but readers requiring further information or confirmation of arrangements should contact the organizers.

February 9

The Society of Instrument Technology (Manchester Section). At the 'Manchester Room', Central Library, St. Peter's Square, Manchester, 1. 6.45 p.m. Meeting on Symposium 'Moisture Measurement'.

The Chemical Society (Manchester Section). In the Large Lecture Theatre, Chemistry Dept., The University, Manchester. 4 p.m. 'Looking for New Drugs', by Dr. F. L. Rose, O.B.E., F.R.I.C., F.R.S. Joint Meeting with the Students' Chemical Society, University of Manchester.

February 11

The Society of Instrument Technology (London Section). At Manson House, 26 Portland Place, London, W.1. 6.30 p.m. 'Measurement, Automatic Control, and Data Reduction as Applied to a Cyclic Plant', by T. A. Lucas, B.Sc., A.R.C.S., A.Inst.P., A.M.Inst.F.

The Chemical Society (Bristol Section). In the Dept. of Chemistry, The University, Bristol. 6.30 p.m. 'Ionic Crystals and their Melts', by Prof. A. R. J. P. Ubbelohde, M.A., D.Sc., F.R.S. Joint Meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

February 12

The Chemical Society (St. Andrews and Dundee Section). In the Chemistry Dept., St. Salvators College, St. Andrews. 5.15 p.m. 'Vitamin B_{12}', by Prof. A. W. Johnson, Ph.D., Sc.D., A.R.C.S. Joint Meeting with the University Chemical Society.

February 17

The Chemical Society (Newcastle upon Tyne). In the Chemistry Dept., King's College, Newcastle. 'Why Polymerization Occurs', by Prof. F. S. Dainton, Ph.D., F.R.S. Joint Meeting with the Royal Institute of Chemistry.

February 18

The Society for Analytical Chemistry (Midlands Section). At Birmingham. 2.30 p.m. Society Meeting. Symposium on 'Food Analysis'.

The Society of Instrument Technology (Bristol Section). At the University of Bristol, Department of Physics, The Royal Fort, Bristol 8. 7.30 p.m. 'Transducers', by R. Russ.

The Society of Instrument Technology (East Midland Section). At Derby & District College of Technology, New Building, Kedleston Road, Derby. 6.45 p.m. Instrument Engineering at the National Institute for Medical Research', by W. C. Lister, B.Sc., M.I.E.E., F.Inst.P., Head of Engineering Division.

The Society of Instrument Technology (Tees-Side Section). At the Cleveland Scientific & Technical Institute, Corporation Road, Middlesbrough. 7.30 p.m. 'The Errors of Instruments—Their Study and Importance', by H. Kenney, M.A.(Cantab.), M.I.Mech.E.

The Chemical Society (Bristol Section). In the Department of Chemistry, The University, Bristol. 5.15 p.m. 'Biogenesis of Porphyrins', by Prof. A. W. Johnson, Ph.D., Sc.D., A.R.C.S. Joint Meeting with the Student Chemical Society.

The Chemical Society (Bristol Section). In the Technical College, Brunswick Road, Gloucester. 7.30 p.m. 'Chemotherapeutic Research', by Dr. F. L. Rose, O.B.E., F.R.I.C., F.R.S. Joint Meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

The Chemical Society (Sheffield Section). In the Chemistry Dept., The University, Sheffield. 4.30 p.m. 'Some Reactions of Bicycloheptadiene', by Prof. R. C. Cookson, M.A., Ph.D. Joint Meeting with the Royal Institute of Chemistry and The University Chemical Society.

February 19

The Society for Analytical Chemistry (Microchemistry Group). At the Postgraduate Medical School, Ducane Road, London, W.12. 6 p.m. Annual General Meeting, followed at 7.15 p.m. by a Joint Meeting with the Biological Methods Group of the Society on 'Micro Methods in Clinical Biochemistry', by Prof. E. J. King, M.A., Ph.D., and demonstrations of apparatus.

February 23

The Society for Analytical Chemistry (Midlands Section). At the University, Birmingham, 15. 7 p.m. Joint Meeting with the Birmingham and Midlands Section of the R.I.C. on some analytical aspects of non-aqueous reactions by Prof. Gutmann.

February 24

The Society of Instrument Technology (South Wales Section). In the University College, Swansea. 6.45 p.m. 'Researches into Non-Linear Control Systems', by Prof. W. Fishwick, M.A., Ph.D., A.M.I.E.E.

February 25

The Chemical Society (Hull Section). In the Organic Lecture Theatre, Chemistry Dept., The University, Hull. 5 p.m. 'Anthranquinone Chemistry', by Dr. S. Coffey, F.R.I.C. Joint Meeting with the University Student Chemical Society.

The Chemical Society (Liverpool Section). In the Dept of Inorganic and Physical Chemistry, The University, Liverpool. 5 p.m. 'Chemotherapy', by Dr. F. L. Rose, O.B.E., F.R.I.C., F.R.S. Joint Meeting with the University Chemical Society.

February 26

The Chemical Society (St. Andrews and Dundee Section). In the Chemistry Dept., St. Salvators College, Dundee. 5.15 p.m. 'The Chemistry of Poisoning', by Dr. A. S. Curry, Joint Meeting with the University Chemical Society and the Royal Institute of Chemistry.

The Chemical Society (Newcastle upon Tyne). In the Chemistry Dept., King's College, Newcastle. Bedson Club Lecture, 'Complexometric Titrations', by Dr. H. M. N. H. Irving, M.A., F.R.I.C.

The Society for Analytical Chemistry (Scottish Section). At the Central Hall Glasgow. 7.15 p.m. Meeting on 'Analytical Methods in the Hygienic Control of Industrial Atmospheres' by J. C. Gage, B.Sc., Ph.D., F.R.I.C., and 'Analytical Problems in the Isolation and Measurement of Traces of Radioactivity in Foodstuffs', by Prof. J. Hawthorn, B.Sc., Ph.D., A.R.C.S.T., F.R.I.C.

March 2

The Society of Instrument Technology (South Yorkshire Section). At the University, St. George's Square, Sheffield, 1. 7 p.m. 'A Discussion on Preventative Maintenance', preceded by Introductions by E. Dowson, H. E. Farrar and M. Thomas.

March 3

The Chemical Society (Aberystwyth Section). In the Edward Davies Chemical Laboratories, University College of Wales. 5 p.m. Lecture, 'Death by Poisoning', by Dr. A. C. Hunt.

The Chemical Society (Bristol Section). In the Dept. of Chemistry, The University, Bristol. 6.30 p.m. 'Some Aspects of the Photographic Reproduction of Colour', by Dr. H. Baines, F.R.I.C. Joint Meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

The Chemical Society (Manchester Section). In Room C6, Royal Technical College, Salford. 5 p.m. 'Recent Developments in the Chemistry of Some Less Common Elements', by Prof. R. S. Nyholm, F.R.I.C., F.R.S. Joint Meeting with the Students' Chemical Society, Royal Technical College, Salford.

March 4

The Chemical Society (Birmingham Section). In the Large Chemistry Lecture Theatre, The University, Birmingham. 4.30 p.m. 'Weak, Very Weak, and Extremely Weak Bonds', by Dr. L. J. Bellamy.

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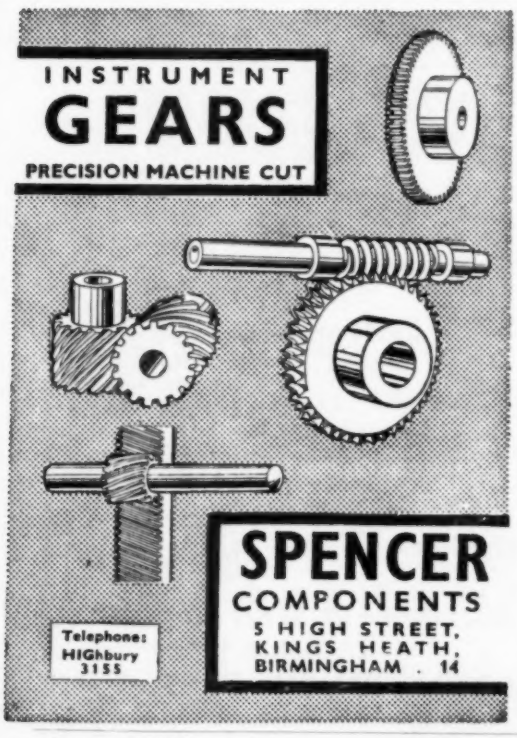

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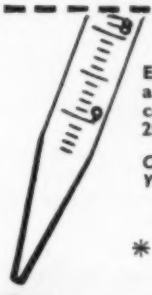

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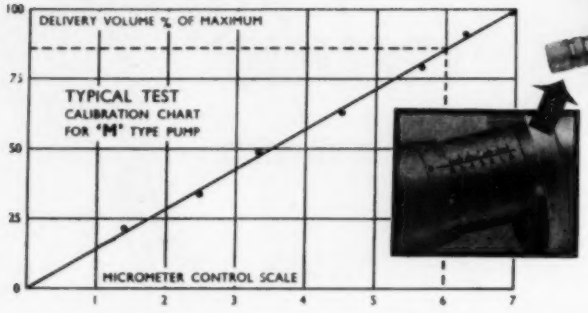

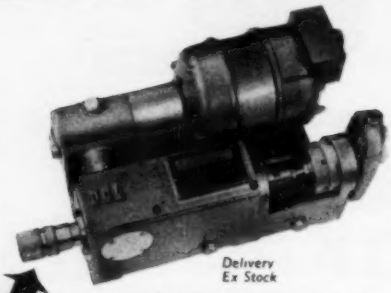

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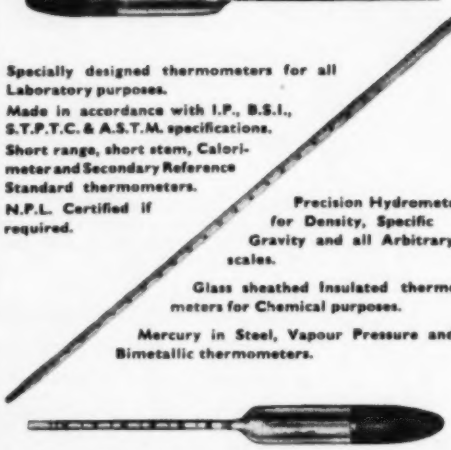

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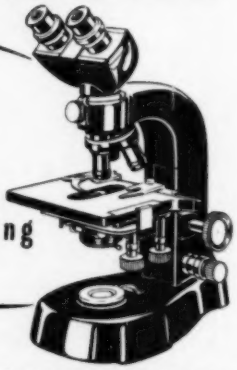

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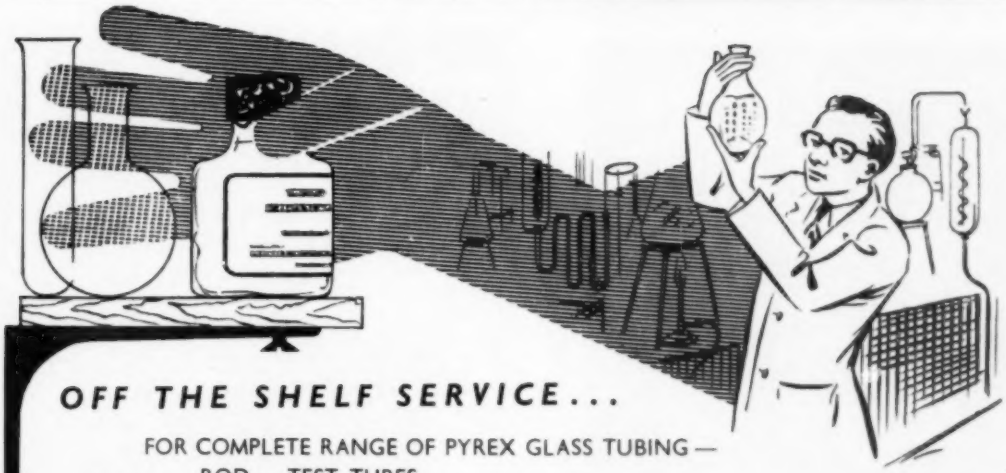

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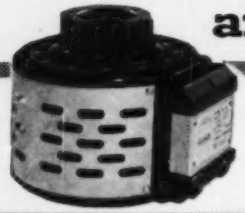

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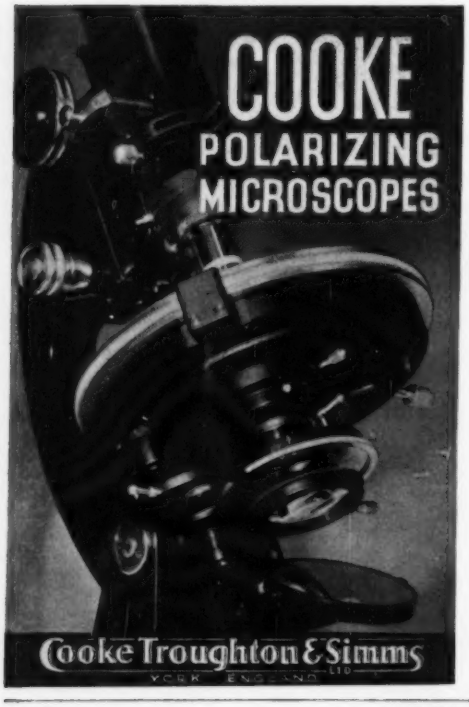

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